OCTOBER, 1950

The Review of Gastroenterology

OFFICIAL PUBLICATION

NATIONAL GASTROENTEROLOGICAL ASSOCIATION

Significance of the Gastrointestinal Tract in Emotional Maturation

Gastric Analysis — Practical or Useless?

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VOLUME 17 NUMBER 10

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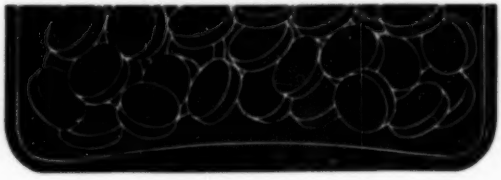

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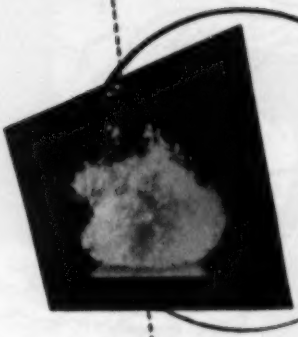

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The Pioneer Journal of Gastroenterology, Proctology and Allied Subjects in the United States and Canada

VOLUME 17 OCTOBER, 1950 NUMBER 10

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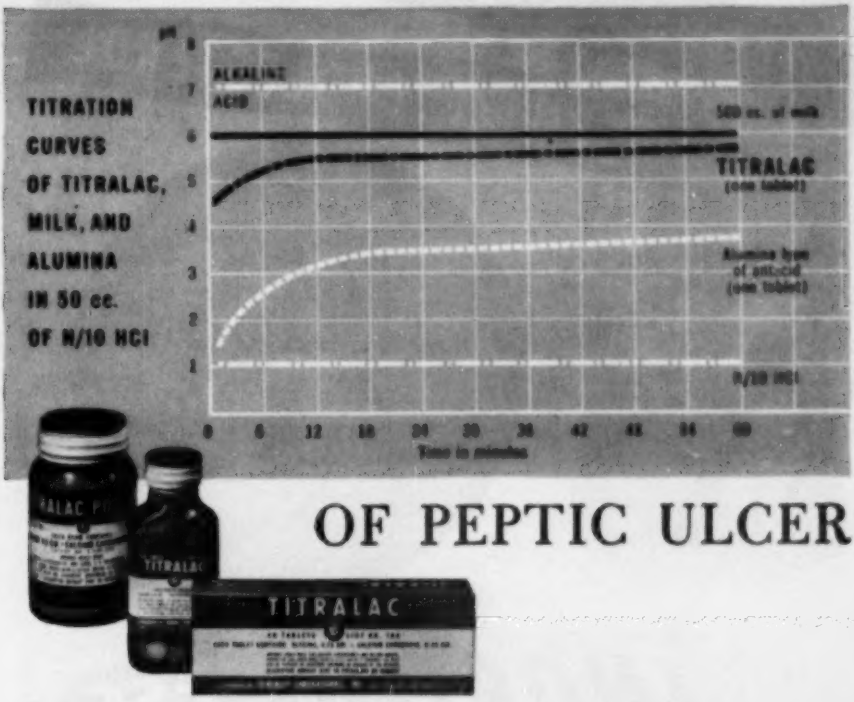

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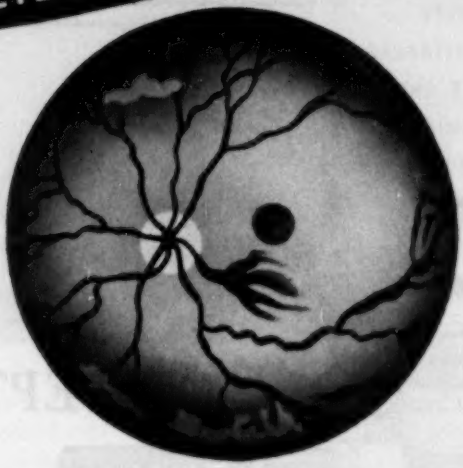

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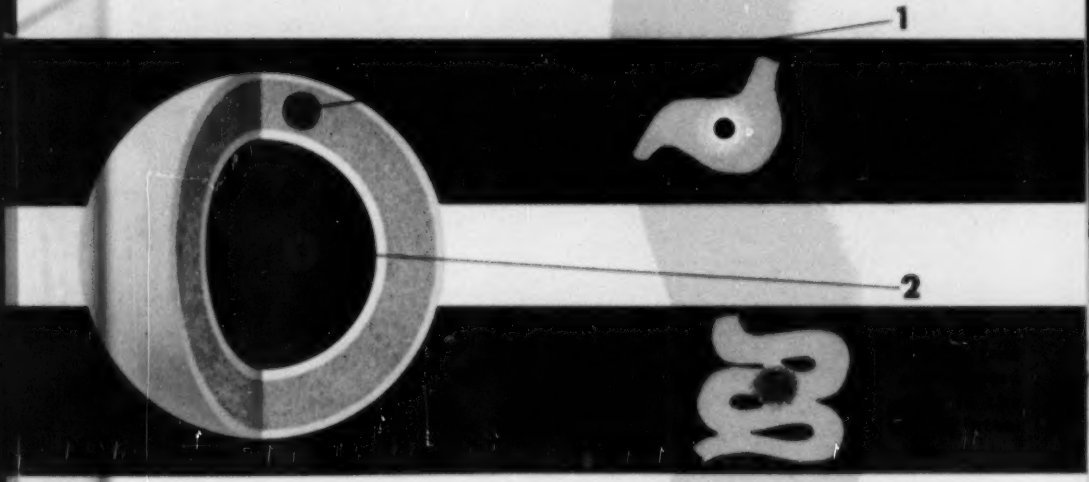

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Volume 17 OCTOBER, 1950 Number 10

SIGNIFICANCE OF THE GASTROINTESTINAL TRACT IN EMOTIONAL MATURATION*†

HENRY M. FOX, M. D.**
Boston, Mass.

The specialist in gastroenterology has more experience with the emotional and psychological factors which play a part in human illness than any other physician outside the field of psychiatry itself. The psychiatrist deals primarily with patients whose complaints and problems are expressed more or less directly in terms of emotional disturbances and various difficulties in personal relationships. In the course of the treatment of most of the neurotic states temporary disturbances of the gastrointestinal tract occur at times when certain kinds of upsetting emotional material is being discussed. But the gastroenterologist, more than any other specialist including the psychiatrist, has the widest experience in dealing with patients whose emotional problems present themselves primarily as a disturbance of gastrointestinal function. During the past few years there has been an increasing tendency toward close cooperation in the study of some of the best known gastroenterological problems, such as ulcer and colitis, where there are excellent opportunities for the surgeon, the general internist, the specialist in gastroenterology, and the psychiatrist to work together.

The psychiatrist has become especially interested in this field as an outgrowth of new knowledge which has been established concerning the period of childhood emotional development. The infant's relationship to the most important people in his family (particularly his mother) can only be expressed in what might be described as somatic language. Long before the young child can speak he has learned to react physiologically to the emotional attitudes of those who are taking care of him. The importance of these early personal reactions has now been demonstrated not only through the reconstruction of childhood happenings worked out retrospectively during the analysis of emotionally disturbed adults but also in a more direct

*Read before the Fourteenth Annual Convention of the National Gastroenterological Association, Boston, Mass., 24, 25, 26 October 1949.

†From the Medical Clinic of the Peter Bent Brigham Hospital and the Department of Psychiatry, Harvard Medical School.

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fashion with the help of new technics which have made it possible to make scientific observations of children themselves.

During early infancy the mouth and what goes into it is, of course, of primary importance. While sucking at the breast or bottle the infant gets his vital nourishment but at the same time learns a great deal about his relationship to the person who is feeding him. The way that his mother holds him, the tone of her voice, and the rhythm of her movements convey vital messages to the suckling infant concerning the exact shade of her feelings for him. Gastroenterologists are very familiar with the fact that many of the feeding disturbances of early childhood can only be understood in terms of the child's reaction to a negative attitude on the part of the mother who, for one reason or another, may feel overanxious, overprotective, or even frankly hostile and rejecting toward the child who responds to an absence of affection by losing his appetite, refusing his food, or even in some cases by vomiting.

In his epoch-making "Three Contributions to the Theory of Sex", Freud first drew our attention to the fact that the mucus-lined openings of the body, including the mouth, the urethra, and the anus, become the foci of emotional interest to the child because of certain experiences and interests quite apart from the primary use of these openings for ingestion and excretion. The thumb-sucking of infancy is perhaps the most striking illustration of the way in which the mouth is used by the infant for sensual gratification. Freud, at a time when it was most unpopular to do so, had the courage to point out that children have erotic fantasies and libidinal urges which are quite different, to be sure, from the genital impulses of adults but which are nonetheless characterized by great emotional intensity. Even an adult who is thoroughly open-minded on the question of infantile sexuality may have a certain amount of difficulty in grasping its full significance. In the first place most of our memories concerning what happened previous to the age of 4 or 5 years cannot under ordinary circumstances be recalled. Perhaps the reason for this is the fact that human beings are so utterly helpless during the early years that we need to forget some of the experiences which have so much guilt and fear attached to them. Direct observation of children can tell us a good deal about what goes on at this period, but children also develop early a need to disguise some of these intense feelings not only from others but also from themselves; and, although some of their activities, such as infantile masturbation, are openly sexual, it is only by indirect methods such as play therapy where various dolls stand for the important members of the surrounding family that we gain an access to the deeper feelings of the child. But there is an even more important reason which results from the fact that as we grow up we, to a large extent, lose the capacity for intense sensual gratification derived from both ends of the gastrointestinal tract during childhood. To most adults, for instance, the reaction to fecal soiling is one of disgust. It is hard for us to realize that children do not originally have such negative feelings about their excremental products and that the reaction of disgust is a later development. As long as the urine and feces remain warm, most young children do not protest, and it is the adult who initiates the change to clean diapers. Anyone who has

watched a young child defecate realizes that it may be an intensely pleasurable performance. Children are very much interested in what they have produced, moreover, and many of them go through a period during which they play with their feces, smear them around, and some children have a tendency to put fecal material into their mouths.

It is of the greatest significance in the personal development of the child that just when his interest in his fecal production is at its height he first experiences the restraining social demands of those who are taking care of him, in the form of pressure to defecate at a certain time and in a certain place. Where the relationship to the adult who is carrying out the training is largely an affectionate one, the child is willing to give up his original instinctual pleasures in exchange for the loving approval of the adult. As all gastroenterologists who have had much to do with children very well know, the whole question of toilet training can become a focus for a severe clash of wills between some mothers and their children. This can result in certain forms of stubborn constipation which may provide the basis for a good deal of trouble later on.

One of the most surprising discoveries of psychoanalysis has been the fact that there is a close relationship between the formation of certain character traits and the emotional attitudes associated with the utilization in childhood of each end of the gastrointestinal tract. At the time that the child is nursing or sucking from his bottle, he is passively dependent. His emotional state is necessarily that of receptivity not only of food but of whatever affection his parents are willing to bestow upon him. He is unable to do anything for himself, and he has not yet developed the capacity for appreciating the emotions of anyone else except as they affect himself. Actually the child's differentiation of himself as an individual distinct from other individuals is a comparatively late achievement. The child's first lesson in this regard comes from the fact that soon after he is born he begins to feel intensely uncomfortable because he is hungry. He can only gain satisfaction from sources outside himself, and if he is left in a hungry condition too long he develops intense anxiety. He has no ability to appreciate his mother as a distinct individual any more than he is able to conceive of himself in such terms. To him the nipple he has in his mouth from which he gets warm milk, the sensation of warmth and comfort he feels as he is held in his mother's arms and the soothing tone of her voice when she speaks to him are about all that he knows about his mother, and it is a long time before he really distinguishes her as a person separate from himself. Thus the passive dependence of the infant becomes intimately associated with the process of filling the mouth and stomach with food.

As the child grows older he is encouraged to stand on his own feet to an increasing extent, and by the time he approaches adulthood he has learned to push his childhood cravings for passive dependence into the background. In all human beings throughout life, however, there is not only an urge for independence and adventure, but there is also a persistent yearning for security and protection. These longings persist in all of us, and if they are not granted conscious recognition

they continue to exert pressure for some sort of expression. What we speak of as the process of repression occurs in all of us during the early childhood period. This is a rather primitive reaction of the individual to emotional conflicts which threaten to overwhelm him. As indicated above, the emotions of childhood are peculiarly intense. There is very little of the more mature tendency for a fusion of positive and negative feelings, and the child feels affection as well as hatred and anxiety very strongly. His complete dependence on the good will of the adults who are looking after him makes it particularly difficult for him to cope with his feelings of hostility toward the persons upon whom he must rely for his very survival. If for some reason he is deprived of sufficient quantities of reassuring affection, he may find it so difficult to master his anxieties that he reacts by "forgetting" the emotions and situations which gave rise to these painful feelings. This is, of course, a pattern of response rather than a process which is consciously decided upon. Feelings which have been repressed in this manner do not disappear, and although they become unconscious they continue to exert pressure for discharge. Repressed feelings are isolated from the further experiences of the maturing individual and thus remain intact so that their original primitive character remains unaltered. They can only reach consciousness disguised in dreams and fantasies, but these repressed energies exert pressure on the sympathetic and parasympathetic nervous systems and thus affect the function of the gastrointestinal tract. The grown-up individual, for instance, who has excessively repressed his need for passive dependence is most apt to develop functional digestive disturbances finally resulting in conditions such as duodenal ulcer. We have learned in this regard that what was formerly described as the typical "ulcer type"—namely the hard-driving, grim-faced businessman accounts for only a part of the story. It is now generally agreed by those who have made a careful psychological study of patients with ulcer that the chief conflict has to do with the disparity between conscious strivings for independent self-assertion to the point of overcompensation and the repressed unconscious wishes to be passively dependent. Franz Alexander's theories of the way in which this situation leads to the formation of ulcer in some patients are well known. They are based on the fact that stomach contractions occur in response to psychic stimulation, such as the discussion of appetizing foods, and on the observation that certain emotional influences can also stimulate these contractions—particularly hunger for the kind of affection which the mother bestows upon the passive infant. The more recent data reported by Harold Wolff concerning his patient with a stomach fistula have provided direct confirmation of the fact that various emotions produce profound alterations in the blood supply and in the general nervous activity of the stomach. Gastroenterologists are well aware of the delicate chemical balances existing in the gastroduodenal area and the ease with which alterations in the local blood supply to the mucosa can result in the disturbances leading to pathological structural alterations.

This discussion of passive dependence thus illustrates the way in which the fate of certain early emotional attitudes becomes bound up with the function of

the mouth and the stomach in a way which is only indirectly related to the process of ingesting food. By the time the infant has developed teeth, he has also begun to assert himself more effectively and with greater aggression. He has begun to test out the world around him and much of this exploration is carried out in terms of what he can reach with his hands, what he can bring to his mouth, and the degree to which external objects resist his tendency to bite them and to chew them up. Colloquial expressions such as "gnawing resentment" or "biting envy" indicate the degree to which adult language retains the association between certain emotional attitudes and the use of the teeth.

An understanding of the significant personal conflicts associated with a clinical condition such as ulcer is particularly valuable because of the help it gives us in treating our patients more effectively. Most psychiatrists who have worked with ulcer patients agree that the fundamental emotional disturbances are deeply ingrained in the character of the individual. The permanent relief from the effects of these conflicts requires time and skill, and it is only certain patients who are suitable candidates for such treatment. On the other hand, it has been demonstrated to an increasing extent that an adequate psychological understanding of the patient suffering from ulcer contributes significantly to the successful medical or surgical handling of the case even though the underlying emotional conflicts remain unresolved. During the acute phase of the illness, for instance, it may be necessary to provide a good deal of psychological support and to make sure that the patient's underlying needs for being taken care of in an emotional way are fully met. The usual regime of bedrest and the soft foods of infancy help to establish this situation, and the physician who is able to create an atmosphere of confidence and understanding helps to give the patient what he needs at this stage. As the patient recovers it is particularly important for the physician to develop an understanding of the resentments which always accompany the need for dependence. As has often been pointed out, the patient with ulcer is very apt to be the kind of person who, so to speak, "swallows" his resentments and finds it very difficult to give them conscious recognition or to express them in any outward fashion. As he gets to know the personal relationships of his patients, the physician recognizes patterns such as these and at times he may be able to give a good deal of relief by encouraging his patient to express feelings which he has tended to repress. Here, as in any other psychotherapeutic situation, the physician must use a good deal of judgment concerning the degree to which his patient is sensitive to certain material, and care must be exercised to avoid arousing more anxiety than the patient can comfortably handle.

Since the gastroenterologist is frequently interested in putting his patient on one or another specific diet, it is important for him to understand the meaning of food to the patient in psychological as well as nutritional terms. Here again the emotional situation of early infancy has given us some important clues. As we have seen, maternal feeding and maternal affection are experienced together, and in early childhood the activities of the mouth have an extraordinarily high value

because of their sensual and emotional implication. If for one reason or another the progress of emotional maturation has been uneven or incomplete, then there is a tendency for the individual to regress to the more primitive emotional situation under conditions of stress and even to look upon food as a substitute for the affection he has been unable to achieve. Thus the physician who is most successful in helping an obese person to reduce somehow manages to provide a good deal of psychological support in his relationship to the patient which compensates for the emotional deprivation associated with giving up certain foods. An impatient demanding attitude on the part of the physician, on the other hand, may arouse a good deal of hostility in such a patient which is rarely expressed in direct verbal terms but instead manifests itself as an intensification of the tendency to devour large quantities of the forbidden food.

It is very easy to underestimate the emotional significance of food which goes far beyond the satisfaction of physical hunger. The fairy stories of childhood are full of what we might speak of as food magic. Many of these stories have come down from very ancient times, and they convey a primitive type of oral symbolism. The story of Hansel and Gretel, for instance, illustrates the way in which hunger and abandonment (in this instance by the cruel stepmother) are equated in the mind of the child. Those who have read the story recently remember that it is when Hansel's breadcrumbs have been eaten up by the birds that he is no longer able to find his way home and he and Gretel become lost in the woods. The sugar house of the old witch on which they nibbled next morning illustrates the childhood belief that even sweet foods from a person who is hostile can result in disastrous consequences. The ogres in other stories with their huge mouths and big teeth and the wolf in Red Riding Hood who gobbled up the grandmother are personifications of childhood fears concerning aggressive impulses to chew up and devour which are easily projected onto powerful figures in the immediate environment whom the child is afraid will retaliate by gobbling him up in turn. The child and the primitive person behave as though the swallowing of certain substances in itself produces a magical effect—certain tribes, for instance, believe that eating the heart of a lion confers the lion's strength. All of these considerations have a practical bearing on our treatment of patients because an unconscious persistence of such fantasies may account for some of the quasimagical faith in pills and injections which goes far beyond the pharmacological effects of these substances. There are times, to be sure, when it is useful for the physician to be able to prescribe medication which he knows will have a symbolic as well as a pharmacological effect on his patient. This is not apt to be harmful as long as the physician is fully aware of what he is doing and does not himself become a victim to a magical belief in what can be accomplished in this way. The administration of too many pills and drugs can, of course, be confusing and harmful when the patient is thus encouraged to depend on an extraneous substance which he swallows instead of being encouraged to deal more directly with the disturbing feelings and attitudes which may be the actual basis of his physiological difficulties. It is very easy to fall into the pattern of relying

on pills and procedures because patients would much rather avoid thinking about disturbing personal problems, and they are grateful for the physician's encouragement to avoid responsibility for the personal conflicts from which they may be suffering. There are times, of course, when it is highly desirable to give a patient the kind of support which makes it unnecessary for him to think too much about difficulties which he is not yet strong enough to master. On the other hand, the physician who is insensitive to the personal anxieties of his patients is apt to render it much more difficult for them to make the necessary effort to confront their emotional difficulties. This is true not only of medication but also of some of the medical regimes which we impose upon our patients and which may have a good deal of rational indication at the outset. At a later stage of convalescence, however, they may degenerate into a kind of ritual rendering it more difficult for the patient to come to grips with his fundamental personal problems which may have been the cause of his illness in the first place. Here again the dependent patient is apt to welcome a set regime, and he may even resist the termination of a ritual which has become symbolic of his passive reliance on the physician who is taking care of him. It is true that it takes a little more energy and imagination on our part to deal more directly with the personal factors in the situation, but it is certainly much more rewarding in terms of permanent recovery.

A number of illustrations have been given concerning the way in which certain personal conflicts having to do with passive dependence are intimately related to the functioning of the oral end of the gastrointestinal tract. The childhood feelings and attitudes concerning the lower end of the gastrointestinal tract have an even more direct bearing on the establishment of specific character traits and personal attitudes. The erotic impulses associated with the mouth are retained to a large extent in the adult as part of the foreplay which may eventually lead to full-fledged sexual union. The sensual pleasure connected with the lower end of the gastrointestinal tract, on the other hand, becomes almost completely repressed. Some of the instinctual energy which was originally focused on the process of defecation becomes transformed into various socially useful activities. The urge to smear with the feces, for instance, becomes deflected into such activities as playing with mud or sand, smearing with paint, and finally with the help of the educational process these forces may become channeled into creative artistic production. As in the case of the attitudes toward food, it is very easy for the adult to underestimate the strength of the emotional forces which are associated with anal activities during the childhood period. Well known vulgar expressions of speech using gastrointestinal terminology illustrate the violent hostility which may be associated with the process of defecation. On the other hand, the child derives great enjoyment from the stimulation of his rectal mucous membrane by the column of feces which he is expelling. He also derives an enjoyable sense of power from his newly acquired capacity to control his sphincter. The period of life when interest in these functions is at its height coincides with the infant's rapidly increasing urge to assert himself as a distinct individual. He is emerging from the preceding period

of completely helpless dependence and now develops a feeling of power and command symbolized, perhaps, by the humorous comparison of the toilet to the throne. The process of defecation may express feelings of hostile expulsion, but the process may also be expressive of an affectionate gift which the child produces for the parents, particularly the mother, and which he expects her to admire with suitable enthusiasm. One of the most surprising discoveries of psychoanalysis is the fact that adult character traits such as stinginess, excessive orderliness, and obstinacy represent the outcome of permanent reactions to frustrations and repressions of the erotic and aggressive energies connected with defecation during early childhood. The emotional development at this period may be warped in the sense that an unusual quantity of hostile feeling has been repressed instead of becoming transformed into socially acceptable aggressive activity. Such an individual may later on in life become vulnerable to emotional influences affecting the functioning of the lower bowel either in the form of diarrhea or of constipation. Some of the more fulminating types of colitis occur in individuals with an emotional make-up which has not progressed beyond the primitive childhood situation where intense expulsive hostility alternates with stubborn retentive dependence. Such individuals may have great difficulty in establishing durable affectionate relationships to others. During their illness they may become exceedingly trying because of their constant need to test out the emotional trustworthiness of those who are caring for them. This is the kind of treatment situation in which the psychiatrist and the gastroenterologist do well to collaborate. The psychiatrist is usually interested in evaluating the response of the patient to all of the different people who come into contact with him, and often the most successful results have been obtained by entrusting the major share of the personal therapy of the patient to a nurse, a house officer, or some other member of the therapeutic team with whom the patient is able to establish a reasonably dependable relationship.

Although we have discussed the oral and the anal phases of emotional maturation separately, they overlap in the actual life of the child. In adult disturbances of the emotional life there may be a simultaneous reactivation of conflicts having to do with both of these phases of development. As the child gets older, moreover, his erotic interests become more specifically genital and sexual in the adult sense of these words. But the curiosity concerning genital activities and procreation are apt to retain the gastrointestinal preoccupations of the earlier phases. When children begin to wonder about pregnancy, for instance, they are very apt to develop fantasies which are in accordance with their primarily gastrointestinal orientation. The belief that the mother's stomach swells up because of something she swallowed is, for example, quite widely held among children, and adults who have not achieved full-fledged emotional maturation continue to have fantasies of this type. Some of the patients with anorexia nervosa, for instance, are found unconsciously to have retained such ideas. Since most little girls are unaware of the existence of the vagina, they are quite apt to confuse parturition with defecation—the so-called cloacal theory of childbirth which has a biological basis in the embryological rela-

tionship of the vagina to the rectum and which may be reinforced psychologically when the child discovers that ducks and hens lay eggs. Many of the hysterical disturbances of the gastrointestinal tract are associated with fantasies of this type.

The tendency of the above discussion has been to call attention to the relationship of clinical disturbances of the gastrointestinal tract to long-standing patterns of character. The origin of these patterns in the various phases of childhood development has been stressed, and it follows quite naturally from this that psychotherapy which brings about any fundamental alteration in these patterns requires a considerable amount of time and special skill. But even though the basic emotional conflicts remain unresolved, it seems evident that a better psychological understanding of patients suffering from functional disturbances of the gastrointestinal tract enables the gastroenterologist to handle his patients much more successfully. A sensitivity to the depth and complexity of the emotional problems which play a part in the illness counteracts any tendency to bring about hasty "solutions" of the patient's problems by attempting, for instance, more or less "surgically" to eliminate from the patient's life a close relative whose influence seems to be disturbing or by attempting to bring about some drastic alteration in the environmental situation without adequate consideration of what the implications might be. An awareness of the psychological factors tends to mitigate excessive reliance on medication, dietary regime, or surgical intervention. On the other hand, thoughtful evaluation of the patient's psychotherapeutic plasticity helps the gastroenterologist to make a balanced judgment concerning the value of surgery in certain clinical situations where such procedures may be of great practical benefit to the patient even though the underlying etiology may originally have been psychological and functional. Collaboration of surgeons, gastroenterologists and psychiatrists has already improved the treatment of patients with disturbances of the gastrointestinal tract, and there seems every reason to expect that increased cooperation of these specialists will make further contributions in the future.

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Discussion

Dr. Jerome S. Levy (Little Rock, Ark.):—It was gratifying to hear Dr. Fox's holistic approach to psychosomatic medicine. The massive volume of the literature on this phase of medicine has almost overwhelmed medical thinking in the past few years. We are inclined to consider it a new approach to therapeutics.

Houston, in his excellent book published in 1936, entitled "The Art of Treatment", made several comments which I quote: "Medical thought is rightly united only when every effort is bent toward treatment", and he divided the difficulties of therapy into four main ones, of which one is "a very great difficulty in getting to know the man that has the disease, to understand his environment and with what emotions he reacts to it, to know the psychobiology of the individual". He further wrote: "The greatest single failure in medicine today is the failure to recognize the limitations of the mechanistic methods".

I feel this is worthy of quoting, for this thought seems to have been a motivating factor in the present-day emphasis upon psychosomatic medicine. This emphasis has become so great that some physicians have adopted the conception that all disease is the result of a basic emotional conflict without any organic cause. It is to be hoped that we do not reach such a stage that the greatest single fault in medicine becomes the failure to accept an organic basis for disease, attributing it all to emotional factors. I was pleased to hear Dr. Fox, a psychiatrist, credit to the soma an influence on the psyche rather than giving exclusive rights to the psychic to unrelentlessly affect the somatic. It encourages me to believe that possibly we are close to the stage of accepting the reciprocal relationship of the soma and the psyche.

Dr. Fox has not presented any astounding discoveries, newly arrived at, but rather he has summarized for us the current psychoanalytical and psychiatric (if I may separate them) thinking on the manner of emotional maturation as influenced by the gastrointestinal tract. It is not difficult for us to understand that an infant early associates feeding with a sense of security, for it brings him relief from a discomfort we call hunger; nor is it difficult to understand that the loving care and tender handling of the infant during nursing brings it a sense of affection and warmth which becomes love as the baby grows older. They satisfy the infant's needs. This receptivity is easily understood, and the oral association is within comprehension; however, I believe the importance of the anal characteristics may have been given disproportionate emphasis.

I grant that the baby learns, probably as its first lesson of this kind, to do something asked of it by others and to control its instinctual physiological urge in order to please someone else—parents or nurse. I think we stretch our evidence too far in concluding that in all cases the adult characteristics of stinginess, excessive orderliness, and obstinacy represent the outcome of permanent reactions to frustration and repressions of the erotic and aggressive energies connected with defecation during early childhood.

This concept is confusing to me when I recall that even animals learn to keep their nests or living quarters clean. A puppy will not soil the small area in which it sleeps unless he is so confined he cannot hold his feces any longer. I believe that to attribute these characteristics solely to anal sources is to overlook the factors of training, neglect, and biological heritage, and to neglect the importance of the close association of the child with his parents and nurse and their characteristics of orderliness, and so forth, during the first ten years of his life. Too often have I observed my own child copy what I have done, even though she has seen me do it but once, not to believe that the child copies what it sees done. Many of the traits attributed to oral or anal characteristics are merely copy tactics.

The amount of so-called erotic energy localized in various portions of the body is not necessarily solely determined by bowel training. That certain portions of the body become areas of special concern to the baby can be due as well to variations in the individuals, for I don't believe we are all created equal in this respect. Some infants require more oral activity than others, regardless of the feeding situation and the affectionate care given by the mother; and, by the same token, more anal activity regardless of the bowel-training technics. I do not think it can be denied that some infants, on a constitutional basis, are more sensual in the anal region than others, thus becoming more readily influenced to preoccupation with that region.

The constitutional inheritance of the infant may produce varying amounts of resistance or flexibility, resisting or being variably influenced by training and environment. The limits of this variablity or flexibility may be very narrow and only within certain limits in some, and within wider limits in others.

Dr. Fox strayed somewhat from his subject of the influence of the gastrointestinal tract on the emotions to that of the emotions on the gastrointestinal tract. This gives me the opportunity to comment on the psychiatric factors in peptic ulcer.

I am firmly convinced that adequate treatment of peptic ulcer requires careful consideration of the emotional make-up of the patient. There is no doubt that this plays a part in the production of ulcer as does smoking, irregularities of diet, trauma, infection, or abnormalities of secretion and motility, but I consider the emotional conflicts in the same category as these factors which Larimore has labeled "the chronicity factors". For instance, if smoking were the sole cause, we would have so many cases of ulcer, we could not find sufficient facilities to treat them. All who smoke do not develop an ulcer. In the patient with an ulcer diathesis, smoking is definitely a serious factor and may be the precipitating one—yet, there is still an X factor.

Emotional conflicts fall into the same group. All patients with "the chief conflict of disparity between conscious strivings for independent self-assertion to the point of overcompensation and the repressed unconscious wishes to be passively dependent" do not develop ulcers. Why some develop ulcers and others do not still has not been explained and leaves us with the X factor. Yet, as with smoking, this

factor must be taken into consideration in every case, and appropriately managed when present; but this, too, is getting away from the subject title.

I find myself in full agreement with what I believe was Dr. Fox's main purpose in his paper, namely, that we need an approach to this problem of psychosomatic medicine that is both somatic and psychic; in other words, to see the patient as a whole, not broken up into different segments. For years I have emphasized to my students that in every case we must remember that we have a patient who has a disease; not a disease which has happened to pick up a patient. If we have a clear-cut conception of the normal emotional growth as well as the normal physical development, we will understand to a greater degree the emotional reaction of the individual to his disease and the effect on the disease of the patient's emotional make-up.

Most of the papers written on this subject today emphasize abnormal emotional development. Dr. Fox, however, has outlined for us the normal course as influenced by the gastrointestinal tract. If we concentrate our interest on this, his presentation becomes extremely important to us and he is due our thanks for his contribution.

Dr. Merrill Moore (Boston, Mass.):—This paper contains an extremely able summary of existing knowledge, slanted from the point of view of the normal person, and also some subtle points, nice distinctions, and interesting original ideas contributed by Dr. Fox himself. For example Dr. Fox's term "Symptoms are *somatic language*" contains a wonderful idea—stimulating to the imagination, and provocative to the intellect. His paper is sprinkled with phrases like that. "Somatic language" is an idea we might all remember when our patients speak to us, because the symptoms the patients describe are actually a form of communication earlier than speech, and often more primitive and meaningful than the verbalized form in which they are given to us.

You will remember that in the formation of the embryo, the neural crests begin to rise along the back to form the neural groove which lies between them; later the primitive gut forms beneath the neural groove; and at one time they are connected by the neurenteric canal. Dr. Fox reminds us that "oral" and "anal" patterns have similar relationships in the early structure of the personality. Perhaps we would do well to use the term "intestinal" to describe this stage of personality formation instead of "oral" and "anal" because the term "intestinal" combines both ideas effectively. Dr. Fox also mentions the "physiology of forgetting". We need to know more about that. Dr. Fox speaks of "gnawing resentment" and "biting envy". These neat phrases represent the original point of view he has brought to the preparation of this paper.

We psychiatrists are often limited in what we may accomplish because we see patients too little or too late. We suffer from the stigma of being psychiatrists while you as clinicians, gastroenterologists and true internists are more respectable and less to be feared. Besides you see patients earlier than we do in the course of

their illnesses. With these great advantages you may discover new approaches that we may not have the opportunity to see.

Dr. Fox has utilized certain references to fairy tales in making his presentation. Fairy tales also are a form of primitive language related to fantasy and myth. Often, the stories that our patients tell us about their symptoms, especially in relation to their feeding and bowel training habits are a kind of fabrication or mixture of what they remember and what they have fantasied, comparable to the legendary stage in the development of literature. It takes a shrewd clinician to separate these points but the experience that training in gastroenterology gives, plus some awareness of recently developed psychiatric ideas, enables fresh distinctions and new clinical standards to be set up. This is one way in which our theory of gastroenterology develops.

Dr. Fox speaks of "food magic" and "magic food". As a modern example of "food magic" and "magic food" I would cite recent advertisements in The Ladies Home Journal and Good Housekeeping where the associations of mother, food and breast are all so prominently emphasized, including even some "uplift bra" ads in current fashion magazines. Dr. Fox mentions Hansel's bread crumbs which are eaten by birds. It would be interesting if he would extend these remarks because they contain elements of another oral fantasy and ideas that are intriguing and might be elaborated.

The formation of the personality is greatly influenced by early experiences of feeding and elimination. I would strongly disagree with anyone who would minimize the importance of weaning and toilet training. People interested in these points should read the original articles by Dr. Karl Abraham on these aspects of infantile emotional development. The gastroenterological studies of Dr. Franz Alexander and the clinicians who assisted him would be helpful to anyone interested in pursuing these ideas further along psychological lines.

The question comes up: is it harmful to train a child early; or should the parents allow the child to "make a mess" when it pleases? This is an unanswerable question but the child has a lot to say about it in his own "somatic language" (or infantile behavior) and further understanding of this may lead, as Dr. Fox indicates, to more useful discoveries in psychological and psychosomatic medicine.

There is some evidence in my own clinical material gathered while treating neurosis among adults that the transitions from the infantile oral to more mature stages are handled more easily than the transitions from the infantile anal stages towards maturity. In other words, I believe that weaning may be easier than toilet training and toilet training lasts longer than weaning. However weaning may be less obvious as a trauma because normally it occurs on a "deeper" (i.e., earlier) level. Be that as it may, toilet training is complicated, in a psychological sense, and can definitely create difficulties that may lead to symptoms in later life. Somehow, the baby senses his mother's attitude towards him, (or her) and somehow he or she reacts to it, especially on the level of toilet training. This is one important point in development where distinct positive and negative attitudes are set up between

the mother and the child. Dr. Fox speaks of "the cruel stepmother". By this he also indicates negative feelings (or ambivalence) the child may hold towards its own mother. Children are simple. They live in an "either-or" world. Everything must be split in two, that is, *good* versus *bad*, or *good* must conquer *bad*, for primitive acceptance. Dr. Fox's observations about the lack of fusion between these positive and negative emotions in the child is extended further in the fairy tale he refers to in which the figure of the stepmother bears the unadulterated burden of badness. Dr. Fox suggests that the more the mother's favors are acceptable to the child, the more dangerous and guilty children must feel their rejection and hatred of her to be and the more violently they must struggle to repress it. In this and in other ideas Dr. Fox has given us some sound warnings and indications for caution.

Dr. Fox's ideas fit in with the clinical observations we make in child guidance clinics, and in our psychiatric out-patient clinics for adults. Interestingly enough, much of what Dr. Fox says could apply very well to the alcoholic patient, who was always a feeding problem of one sort or another and the male alcoholic is often a person of the passive, dependent type, whereas the female alcoholic is often aggressive, especially on the oral level of behavior. I concur especially with Dr. Fox's opinion that early feelings of insecurity can lead to the first gastrointestinal symptoms—the feeding problems, though it is still a question: which is the cart and which is the horse?

I believe that children who are accepted by both parents with loving care, who are held in an affectionate way and are fed with tenderness and sympathy, are much less inclined to become our patients fifteen, twenty or even thirty years later, with "ulcer" and "colitis" syndromes. There is probably a specific relationship between the ways in which mothers feed and toilet train their children and these very "diseases" that clog our clinics today.

Some observers have believed (Fenichel, for example) that it takes the child a long time to differentiate between himself and that which is not himself, especially his first "love object", that not-himself figure who is his mother. Fenichel defines "mother" as the one who gives the child his first care, not necessarily the one who gives birth to the child. I know of no instance where definitive evidence on this point has been dug up during a psychoanalysis, so this assumption needs to be clearly labelled as the hypothesis that it is, and probably must remain. Nevertheless, the idea of the mother as a trusted person who supplies the child's needs somehow develops in the child's mind. Possibly more of an answer to this question may some day come from workers in the field of gastroenterology. Some of the ideas presented in Dr. Fox's paper, if properly followed, might lead to new solutions of unsolved problems in this area.

In this valuable paper Dr. Fox reviews and ties together many important ideas relating to early eating and toilet habits. In brief he suggests letting the child work through the toilet training stage in a reasonable way.

In this connection I want to say a kind word for the contribution of the diaper services towards our efforts to solve toilet training problems.

Naturally most mothers (unless they are coprophiliacs) want to finish the chore of washing the diapers as soon as they can. Perhaps the use of the diaper cleaning services that is spreading widely in some cities may permit mothers to allow their children to exercise their new found power, their control or deliberate letting go of their sphincters, for a longer period, or until they are better able to accept suitable substitutes for anal eroticism and anal sadism in their emotional development. Of course parents must pay for this service and must continue to deal with their own emotional problems. I regard the diaper services as potentially one of the most useful and valuable of social and community institutions developed since Sir John Haryngton invented the water closet. It might be well worthwhile (as a boon to tired mothers and nervous babies) if city governments would install routine diaper service on a par with other municipal sanitary services such as snow removal or garbage collection. A candidate for Mayor might even be elected on such a plank.

As years pass, and our knowledge grows, the clinical picture related to "intestinal" training is becoming more clear. It is our hope through the joint efforts of gastroenterologists and psychiatrists that much more can be reported a few years from now in this extremely important and largely unexplored field.

DESTRUCTIVE FORMS OF HEPATITIS*

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"The pathologist works like the archeologist. He finds only ruins and, from the fragments, he has to re-construct a conception of bygone life."

The pathologic conditions in *allergic hepatitis* previously discussed, can be explained on the basis of a toxic damage to the capillary walls and cell membranes leading to an increased permeability for fluids and electrolytes, and eventually also for colloids such as albumin, according to the degree of the damage. The normal organization of the liver lobules and cell cords remains unchanged. The chief pathologic feature is an effusion into the pericapillary spaces. By interfering with the physiologic metabolic exchange of gas and nutritional products between the pericapillary fluid and the liver cells, this process may eventually lead to cell degeneration and necrosis. Consequently there is no fundamental difference between the allergic and the destructive forms of hepatitis, *but only a difference in the degree of the damage.* Such effusions, by lowering the defense of the liver, may also pave the way for invading germs (viruses).

It is generally recognized that clinical phenomena of an allergic character frequently occur in the prodromal stages of infective hepatitis. They are in many instances of a striking nature, and many of the older investigators were thus led to regard them as the essential pathologic feature. At present, however, it seems to be fairly well established that different virus strains are the cause of acute hepatitis, both in the epidemic and sporadic forms, the so-called catarrhal jaundice, homologous serum hepatitis, acute yellow atrophy, and probably in some forms of liver cirrhosis. The anatomic response of the liver to damage is fairly uniform. The same pathologic changes are demonstrable whether the lesion is infective or toxic. On the other hand, the clinical symptomatology may present a rather confusing variety, because of the fact that some virus strains attack other organs as well as the liver. This is particularly true of the central nervous system.

Scarcity of Autopsy Material a Former Handicap:—Knowledge of the anatomical changes in the liver in *acute hepatitis* has been greatly handicapped until the present time by the scarcity of available autopsy material. This has been due to the low mortality rate in most epidemics, and an even lower rate in the sporadic cases. Acute fulminating cases usually showed signs of acute yellow or red atrophy. In the chronic cases, the cirrhosis present in the terminal stages permitted a demonstration only of combined destructive and reparative processes which have taken place over a long period.

With the recently developed method of taking biopsy specimens by needle aspiration at repeated intervals, it has been possible to gain a much better knowl-

*This is the second of a series on hepatitis.

edge of the anatomical and pathological changes in the different stages of the disease. It has demonstrated the amazing regenerative power of the liver that persists even after the most extensive destruction.

Aspiration of Liver Tissues

Aspiration of liver tissue for diagnostic purposes was carried out quite some time ago (1895) by Fucatello, Oliver and Scalabrina. Results were not satisfactory, however, because the material obtained was usually insufficient for extensive examination. With the use of larger cannulas (2 mm. wide), liver specimen cylinders adequate for all examinations can be aspirated. The method developed by P. Iversen and K. Roholt has been used by many clinicians, with highly satisfactory results.

Two routes are employed for liver aspiration, namely the transdiaphragmatic and the abominal routes. In our opinion, the former is safer and less likely to give rise to complications. Bleeding is also more easily controlled in the area where the liver is in close contact with the diaphragm. However each case should be treated individually in choosing the place, which appears most suitable for taking the specimen.

Technic of Punch Biopsy Method:—Our procedure is the following: With the patient lying on his left side on the edge of the bed, his right arm elevated, the phrenicocostal space is marked, and the site of the intended aspiration is anesthetized. A 2 per cent novocain-adrenalin solution is used, employing a long needle in order to infiltrate the whole tract through the pleura and diaphragm down to the liver. The aspiration needle usually employed consists of a cannula about 8 inches long, with a 2 mm. bore, and armed with a stylet. The edges of the cannula should be razor-sharp, to obtain a cutting effect by rotating it in its axis. The Silverman-needle with a split inner cannula has definite advantages and is now widely used.

The trochar is advanced through the skin until it reaches the upper surface of the diaphragm, whereupon the needle is withdrawn slightly, to liberate the diaphragm for breathing. The patient is instructed to breathe deeply several times, and to stop in deepest expiration. The trochar is then thrust through the diaphragm into the liver for a distance of about 2 cm. The stylet is withdrawn, and a 10 c.c. syringe is attached to the cannula. While rotating the syringe during aspiration, a cylinder of liver tissue measuring about 1 to 2 cm. in length and 2 mm. in diameter is withdrawn. The tissue cast is then fixed and treated. The aspirated liver fragments are at times of inadequate size, and for this reason it is recommended that the trochar be rotated slowly as it penetrates into the liver, so that the sharp edges can cut the tissue. Otherwise the latter may be only pierced and detached, with the result that the aspirated specimen will contain only a few small fragments of tissue with liver cells, but no sample of the more solid structure.

Possible Dangers:—The authors fully agree with Dible and his co-workers that liver aspiration is safer than spleen puncture, and of much greater value. Hemorrhage is assumed to be the chief danger associated with the method. Patients

may be tested for hemorrhagic diathesis by determining the bleeding and coagulation time. Aspiration should be avoided or postponed if a congestion of the liver is present. In jaundiced patients Vitamin K should be administered for two to three days as a prophylactic measure, and the patient should be made ready for blood transfusion. In a collection of 1,200 cases of liver biopsy, Sherlock reported eight deaths, one of these patients having been moribund with acute atrophy on admission.

Diagnostic Value of Punch Biopsy:—The diagnostic value of liver biopsy may be considerable. To ascertain whether the jaundice is caused by mechanical obstruction or by hepatitis, examination of a punch biopsy specimen may be the decisive test. The early stages of cirrhosis can be diagnosed by this method. In one Chinese patient, it was possible to establish a diagnosis of glonosinensis.

Aside from its diagnostic significance, this method has contributed valuable information regarding the processes of destruction and reconstruction in hepatitis.

Anatomical Findings in Hepatitis

Macroscopic Findings:—The liver shows no marked changes in acute hepatitis. There may be edema, but the color is normal brown. Glisson's capsule is shiny and shows no signs of the inflammatory effusion observed in the lymphangitic form of hepatitis.

Microscopic Findings:—Microscopically, obliteration of the normal regular structure of the liver lobules and the breaking up of the cell cords is the main feature. This change is especially pronounced in the center of the lobules, where isolated and partly necrotic liver cells can be seen. The central vein, no longer central, lies eccentrically. The cellular necrosis spreads from the center of the lobules outward, while the infiltration spreads inward. Areas of reticulin can be seen in some places, infiltrated with a large number of mononuclear cells, indicating the site of the destroyed and collapsed liver lobules. The interlobular spaces are dilated, and bare bile capillaries can be observed amid cell detritus. In some areas, there appears an extensive communication between the bile capillaries and Disse spaces. The liver cells themselves are enlarged and many mitotic figures may be noted. The cytoplasm of some cells is filled with pigment granules. When destruction has been rapid, no fatty cell degeneration occurs. The wall of the central vein may undergo hyaline thickening. The sinusoidal endothelial cells are enlarged and hyperplastic.

In the portal zones, there is frequently an accumulation of small mononuclear cells, regarding the significance of which there exists some difference of opinion. However, the condensation of reticulin in these areas, as observed by Dible, suggests that collapse of the lobule has taken place and the liver cells have disappeared from these areas. Regeneration of bile ducts can be seen everywhere.

Intracellular Changes:—The following intracellular changes are observed microscopically:

1. Changes in the water content of the cells, either in the form of edema or dehydration

2. Sedimentation of products of metabolism (bile pigments, iron, fat, lipoids)
3. Changes in the mitochondria (diminution of the bodies)
4. Difficulty in staining

Lucke studies 125 cases of *fatal serum hepatitis* in the United States Army personnel and civilians, following vaccination against yellow fever. In these cases only the liver cells were destroyed, while the reticular framework and the sinusoids remained unaltered. The liver cells have a marked ability to multiply and recuperate, so that regeneration and restoration of normal liver function may be complete.

Structural Recovery in Hepatitis

In several cases in which relaparotomy was performed for recurrent trouble due to secondary hepatitis and biliary cirrhosis following cholangitis, one of the authors (P.) removed a liver specimen from the convexity, for biopsy examination. The structural recovery following treatment (common duct drainage or medical treatment) was remarkable in many instances. In acute hepatitis, punch biopsy specimens showed striking pictures of complete structural recovery, even after severe lesions.

Lucke[2] had the opportunity of examining, at postmortem, the livers of 14 patients after recovery from hepatic jaundice. These livers were made available for examination from one week to 14 months after the attack of epidemic hepatitis resulting from unrelated diseases or from fatal accidents. All the livers appeared entirely normal on macroscopic examination, and upon microscopic study. revealed a complete restoration of all liver lobules. Lucke's observations afforded an excellent illustration of the time required for full restoration. In two patients who died of intercurrent diseases during convalescence, repair of the liver lobules was still in process. Cells in the central part of the lobules had not yet been entirely replaced. In three patients examined within a month of clinical recovery, only slight evidence of previous damage remained, and the liver lobules were almost completely restored. In nine patients examined between the first and fourteenth month after recovery, the parenchyma was fully restored.

Lucke states that the destruction affects only the liver cells, while the reticular framework and the sinusoids remain unaltered. There was no evidence of fatty changes or degeneration of cytoplasm such as is observed in yellow fever, in eclampsia, or as a sequel of chemical poisoning. He considers the rapidity and completeness of the cellular destruction very characteristic of epidemic hepatitis. Such a complete regeneration and restoration of the normal liver function, in his opinion, is possible only when the reticulum of the lobules is not involved and the hepatic veins, portal vessels and their stroma have not been destroyed. Otherwise the restoration and reshaping of the hepatic lobules occurs only in an abnormal fashion, at times with extensive fibrosis and impairment of function.

However, clinical observations prove that recovery can still take place even when the vascular framework is seriously affected, as manifested by pronounced ascites and stasis of the portal circulation (hemorrhage from varicose veins) (Turner et al). Lucke also noted changes in the small hepatic veins. Ascites was present

in 60 per cent of the cases, and the spleen was enlarged in approximately 70 per cent, weighing from 200 to 400 grams. Widespread cholemic hemorrhage was a common finding.

The earliest postmortem in a case of epidemic jaundice, namely three days after onset, was described by J. Gaskell[3]. The patient, a girl five years of age, had been subjected to tonsillectomy in the preicteric stage of the hepatitis. She developed jaundice on the day following the operation, and died on the third day of uncontrollable hemorrhage. To quote from the postmortem report: "The liver, 28 ounces in weight, was uniformly yellow and pale. Its substance was swollen, the parenchyma was bulging. The gallbladder contained orange-colored bile, but the contents of the hepatic, cystic and common ducts were colorless, and the ducts were permeable to a probe. Microscopically, the liver showed a general infiltration of Glisson's capsule with inflammatory cells, lymphocytes predominating, even though the finest ramifications of the bile ducts were intact, with normal epithelium. The whole bile duct system throughout the organ was normal and not involved in any inflammatory process. The aspects of the liver cords, however, showed irregularity, desquamation, and degeneration of the liver cells lying free in the lumen of the hepatic vein among inflammatory debris and red blood cells. Neither in the liver cells nor in the Kupfer cells could *any bile pigment* be found."

Lucke emphasizes still another anatomic fact which conforms to the clinical observations, namely, that liver cells may recover completely after a single injury, but *repeated damage, especially at short intervals* before the liver has had a chance to recover, may result in fibrosis and permanent damage. This fact will be referred to again in discussing the significance of sensitization of the liver, both for the incubation period of epidemic hepatitis and for the development of recurrent attacks.

It is remarkable that, in spite of this enormous power of recovery after injury, *no immunity or increased resistance to repeated attacks* of the same or similar nature is noticeable. On the contrary, *each injury to the liver appears to weaken its resistance in general*. This fact, which has been realized for a long time, has been emphasized by many authors (already mentioned by Claude Bernard). Its outstanding practical value lies in regarding all patients as having a *weakened* resistance *and a potential hepatic insufficiency* for a long period following an hepatic attack.

Three *final stages of hepatitis* may be noted: The liver may recover completely with full structural and functional regeneration; it may pass on into the fatal stage of acute necrosis and atrophy; or into the chronic stage of diffuse or lobular cirrhosis.

Hepatojaundice

Jaundice of the hepatocellular type is the leading symptom upon which the diagnosis of destructive jaundice is usually based. The pathogenesis of this type of jaundice has interested physicians for centuries, and has led to the development of numerous theories. On the basis of experimental work and clinical records collected

for many years by Pribram[4], the authors hope to be able to throw some new light on this problem.

A brief *historical review* may not be out of place. The great majority of physicians of the eighteenth and nineteenth centuries still adhered to the "dyscrasic" theory. According to this theory, an abnormal mixture of the body fluids—one of them being bile—was considered the main cause of most internal diseases. Jaundice was therefore attributed to an hyperactivity of the liver, with over-production of bile, and consequently an excess of bile in the blood. Only a few authors (Selley and Stoll, J. P. Frank, Broussais), dissatisfied with the rather vague "dyscrasic" theory, and impressed with the gastroduodenal symptoms, regarded "bilious fever" as a "degeneration of a gastroenteric catarrh", and jaundice itself as being caused by an ascending inflammation. Littré pointed out that the high incidence of jaundice in these fevers proves that involvement of the liver cannot be regarded as a mere complication of gastroduodenal catarrh, and that more probably the gastroduodenitis and liver disease are more intimately related and have a common cause. Similar conceptions were voiced by Stokes and Graves at the beginning of the nineteenth century.

The humoral theory of jaundice was supported to some extent by the discovery of direct transformation of blood into bile, by Virchow, who observed that in old hematomas hemoglobin was transformed into hematoidin, a substance very similar to bilirubin. This discovery brought the first conclusive evidence of an extrahepatic origin of bile pigment. Other physicians, however, believed that obstruction was responsible for all cases of jaundice. To what lengths such mechanical conceptions were carried can be gauged by the fact that many old clinicians of the eighteenth and nineteenth centuries believed that hepatic jaundice might also be caused by fecal masses accumulating in the right colon in constipation (Frerichs).

Theory of Extrahepatic Obstruction:—Virchow, previously a supporter of the hematogenous theory of jaundice, revised his opinion following the impressive observation of a severe inflammation of the duodenum in a case of catarrhal jaundice. He found an edematous swelling of the mucous membrane around the papilla, and a whitish plug consisting of epithelial masses and mucus blocking the papilla of the common duct. Based on these findings, he formulated his mechanical theory of the pathogenesis of catarrhal jaundice, and maintained that similar conditions of a severe duodenal catarrh leading to a swelling of the papilla might also explain the development of jaundice in phosphorus poisoning.

Virchow's theory is now abandoned by most pathologists. However, the idea that obstructive causes—either of an extrahepatic or intrahepatic nature—might play an etiological role, still finds expression in several conceptions. Pavel[5] and his co-workers believe in the etiological importance of the sphincter of Oddi; Mayo-Robson[6], in 1900, maintained that swelling of pancreatic tissue, which often encircles the ampullar part of the common duct, might cause mechanical obstruction by compression.

Many observers, not satisfied with the findings around the papilla and the common duct, and emphasizing the absence of any dilatation of the common duct above the site of the assumed obstruction, believe that any obstruction, if present, must be higher up. Dilatation of the bile capillaries, which might offer a valuable suggestion regarding the location of the obstacle, is found at the periphery of the acini. Here one may observe cracks in the walls, similar to those seen in obstructive jaundice. On the other hand, the larger bile ducts bordering the portal vein branches are narrow, or at least not dilated. The common duct also has a rather narrow lumen, and definitely shows no signs of dilatation. Therefore the conclusion drawn by Aschoff et al, was that the ampulla, the Hering canal, is the site of injury and block.

When the wall of the ampulla is torn, communication is interrupted between the liver cells and the capillary bile ducts. Inflammatory effusion and cellular infiltration in such an instance might interfere with the normal flow of bile into the ducts and, on the other hand, might open communications with the lymph spaces.

Biliary Thrombi:—In many cases of hepatic jaundice, clots and thrombi are observed in the small bile ducts, which "plug the bile capillaries like a cork" (Affassanief), furthering the tearing of the walls and liver cells. Eppinger[7] studied these biliary thrombi with a special staining method. He considers that these thrombi frequently are the real cause of jaundice, in a mechanical sense.

However, there are also many objections to this intrahepatic mechanical theory of jaundice. Hyieda[8], for instance, observed that in experimental poisoning with toluidine, dilatation of the bile capillaries and the appearance of biliary thrombi do not at all coincide with the appearance of jaundice. The latter sometimes precedes the former. The observations of Clara[9] prove that dilatation of the biliary capillaries is not caused by stasis. He observed that such dilatation occurred after the injection of decholin, and in the absence of jaundice. Moreover, the number of these biliary thrombi found in the capillaries is at times very small, and is by no means related to the severity of the jaundice. On the other hand, in the presence of a local obstruction, the network of the capillaries is so widespread that it affords ample opportunity for the escape of bile through communicating bile ducts.

The liver is actually in a position to deal with much larger than normal quantities of bile in case of necessity, as Rich[10] recently pointed out. One hepatic duct may be entirely obstructed by new growth, and nevertheless jaundice may be wholly absent, since the other liver lobe may take over complete biliary drainage without any marked signs of obstruction or regurgitation jaundice. Experiments carried out by P. MacMaster and Rous[11] proved that three-quarters of all bile ducts could be ligated without the occurrence of jaundice. This demonstrates once more the inadequacy of a purely mechanical explanation of jaundice by an assumed intercapillary obstruction found here and there. There is, moreover, the fact that at the onset of jaundice, of whatever intensity, biliary thrombi frequently are rare, their number increasing with the duration of the jaundice. This definitely contraindicates an etiological significance of the biliary thrombi, but rather suggests a secondary deposi-

tion. It is helpful and enlightening to compare jaundice in hepatitis with the retention of metabolic products in the blood in nephritis. One can readily compare the biliary thrombi to the casts in the tubuli of the kidney. *These casts are symptoms of an inflammatory process,* and they are certainly not the *cause* of incomplete diuresis or azotemia in a mechanical sense. The same probably holds true for biliary casts. They are primarily inflammatory effusions, which are secondarily stained with bile. *They constitute one symptom of the inflammatory process involving the whole liver, but not the mechanical cause of jaundice.*

Dilatation of the biliary capillaries is not, as previously mentioned, evidence of peripheral obstruction. Such local dilatation may appear quite independently, and is probably related to the *excretory function* of the liver cells and the *cholokinetic activity* of the capillaries. This point will be discussed later.

Jaundice develops almost regularly in cases of *cholangitis*. However, this is only a complication in some cases of hepatitis and in no way accounts for the development of jaundice in hepatitis in general.

Jaundice Based on Cellular Destruction:—This theory, accepted now by most pathologists, may be outlined in the following way: Disruption and breakdown of the liver cell cords, as regularly observed in destructive hepatitis, leads to rupture of the bile capillaries, particularly in the most vulnerable region, the so-called ampulla (Aschoff, Hyieda). The latter forms the site of junction of the true bile capillaries with the mere intercellular spaces, into which the bile is primarily excreted by the liver cells.

In hepatitis wide communications are torn open between the bile ducts and the interlobular lymph spaces, from which the bile can be readily absorbed into the blood stream. There are, however, many objections to this theory also. While it can be well understood that some bile is absorbed from the necrotic and disrupted liver lobules into the blood stream, this theory fails to explain why bile drainage from the whole liver may stop completely, in spite of the fact that the bile duct system is patent. It cannot explain why, in some instances as early as a few days after the onset of jaundice, the whole bile duct system contains no bile, but, instead, is filled with a turbid, whitish fluid. Furthermore the necrosis does not parallel the intensity of the jaundice in all instances.

In Weil's disease, at postmortem, we have noted in several instances an almost complete absence of necrosis in the liver, whereas during the life of the patient, jaundice was very pronounced. According to Hutchinson[12], this absence of necrosis of the liver cells is in fact the most striking finding in Weil's disease. In acute yellow atrophy, on the other hand, one is surprised to find that at times in the last stages of the disease, when the patient is in coma, bile starts draining into the duodenum and jaundice diminishes. Occasionally at postmortem one may find bile-stained feces in some parts of the bowel, while in other parts the stool is completely acholic (Jones, Minot[13], personal observations). This indicates that the *bilirubinate-producing function* of the liver cells is retained to the last, whereas the *excretion of bile* may cease independently and start again intermittently at any stage of the disease. Observa-

tions during operation on patients with hepatojaundice have furnished additional convincing evidence that none of the previously developed theories cover the actual facts in a satisfactory way.

In our first cases, surgical indications were based on the erroneous assumption of an obstruction, possibly due to stone, or more probably to malignancy. Later, however, we established as indications for surgery, hepatojaundice cases which did not subside within a reasonable time, and which showed a dangerous tendency toward the development of cerebral symptoms and toward progressing into a state of yellow atrophy. In such cases, the following observations were made repeatedly at operation:

1. The liver was enlarged, soft and edematous.
2. The common duct was not dilated and there was no increased back-pressure.
3. The papilla could easily be passed with a sound. Spastic contracture of the sphincter was rare and only of short duration.
4. The gallbladder was distended but, on slight pressure, emptied readily and freely into the duodenum.
5. In some instances the bile was dark and concentrated, while in others no bile was present, being replaced by a whitish fluid containing mucus and precipitations of epithelial débris. Similar masses of mucus and débris were found in the common duct and in the ampulla. This latter finding might give the erroneous impression of a primary mechanical obstruction, as it obviously did in Virchow's famous case. Such plugs of mucus and débris are sometimes found lying loosely in the duct, and pass readily into the duodenum. Doubtless they represent sedimentation from the turbid fluid, a product of glandular secretion, which collects in the bile ducts owing to the absence of bile, which would normally clear the bile duct system by continuous drainage.

This finding was substantiated by roentgen findings of a similar nature where, in the initial stage, there is spastic irritation of the duodenum, later to be followed by a state of atonic paralysis leading to dilatation and stasis.

Biopsy specimens of the liver and postmortem examinations show that the intrahepatic ducts and bile capillaries in some instances contained inspissated bile at an early stage of the disease.

A most enlightening observation has been made by Barber and Osborne. These authors had the rare opportunity of studying the morbid anatomy of an acute icteric hepatitis in a man who suffered an accidental death on the seventh day after the development of jaundice.

The following is quoted from the paper:

"The liver cells were most affected near the central veins of the lobules. The nuclei of the cells show mitotic figures, but even more numerous than the mitotic figures were the hyperchromatic nuclei, which had just completed division. In most parts, the bile capillaries near the central vein were distended with inspissated bile.

There was no bile in the capillaries nor in the small bile ducts at the periphery of the lobules. The bile ducts in the lever were well preserved, contained some uncolored mucoid fluid and were not inflamed."

These findings, in our opinion, demonstrate quite clearly that it is only the excretion of bile from the liver cells which stopped completely. It can, moreover, be demonstrated by the presence of inspissated bile in the capillaries, that further expulsion of bile also stopped completely. This block does not parallel the damage to the liver cells, which show rather definite signs of increased activity, as manifested by mitosis and hyperchromatic nuclei. The intracellular production of bile pigment obviously continues and, owing to the excretory block, there occurs an accumulation in the form of coarse and fine granules within the cells.

In handling cases of hepatitis and jaundice it has been our practice to open the common duct, with the object of relieving an assumed stasis. Upon manipulating the bile ducts we have then been surprised to observe a sudden excretion of normal yellowish bile, at times while the patient was still on the operating table. This phenomenon, for which we can claim no reasonable surgical credit, constitutes a turning point in the whole course of the disease. Bile now flows continuously through the drainage tube, the bilirubin level of the blood serum drops, and the patient recovers.

The present writers are not alone in having made these observations. For more than twenty years similar cases have been reported (Schlegel[14], Laqua[15], Fragnenheim[16], Haberer[17], Bergenfeld[18]). What is the pathologic significance of these observations?

Obviously the answer as to how such an operation works will at the same time explain the pathogenesis of hepatojaundice.

This dramatic onset of bile drainage from the liver induced by simple manipulation of the duct system strongly suggests *the release of a cellular excretory block*, comparable to the onset of diuresis following decapsulation of the kidney, or a sympathectomy.

The production of bile pigment (hepatorubin) still goes on in the liver cells, which show actual signs of increased activity (enlargement and mitotic figures). It may now be considered a well-established fact that the various functions of the liver cells are completely separated in time and intracellular or intralobular geography (Forsgren[19], Giraudel[20], Elton[21]). The center of bile pigment formation is located, according to Elton and Giraudel, in the peripheral part of the lobules around the portal branches, acceptance zone), while the excretory area is located around the central vein. It is a fact that, anatomically, the damage in the liver cells can be detected first around the central vein, thus demonstrating that this excretory region is affected first by the infective agent or toxin. The block is either intralobular or, more likely, intracellular, in some cases complete, in others partial.

Accepting this concept of a partial or complete cellular excretory block as the main cause of the development of hepatojaundice, the following question arises: *Is this block caused by a direct damage to the liver cell itself, or by way of the hepatic*

branches of the sympathetic nerves? In our opinion the answer is supplied by the other findings, and especially by those in the extrahepatic duct system. The intracellular block is apparently followed by, or associated with, a *paralytic dyskinesia* of the whole biliary duct system.

Cholangiographic observations have taught us that the biliary duct system is not one of rigid and motionless tubes, but that it plays an active role in the expulsion of bile. After injection of lipiodol into the common duct, a distinct segmentation of the dye column may be observed, which could not be explained otherwise than by contractions of the duct. Injections of cholokinetic or choloretic substances, like bile salts, cause a dilatation of the bile capillaries (Clara). The first impulse for bile expulsion starts within the liver cells by cellular contraction, simultaneous with a widening of the primary bile capillaries, which may exert a suction-like effect, thus aiding cellular expulsion. This primary cholokinetic impulse releases an expulsatory wave throughout the entire extent of the intra- and extrahepatic bile duct system. The onset of an excretory block in the liver cells or liver lobules may be followed by a general paralytic dyskinesia of the whole bile duct system, including the gallbladder. The gallbladder is likewise incapable of evacuating its contents by a spontaneous contraction, whereas upon slight finger pressure, it drains readily through the patent cystic and common ducts into the duodenum.

Such a paralysis of the bile duct system supplies the answer to the many puzzling questions which have been raised by many observers. Among other things, it explains the regular observation that no B-bile has ever been obtained in hepatojaundice. During duodenal intubation, the paralytic gallbladder does not contract and the liver cells, owing to the excretory block, cannot discharge their store of pigment.

Another interesting finding was a paralytic stasis in the second part of the duodenum. Soon after our first observation of a duodenal stasis and the finding of painless ulcers, we began performing routine x-ray examinations of the duodenum in cases of hepatojaundice. Our observations confirm the similar findings of Pavel and his coworkers. Occasionally, during the initial stages, a spastic irritation of the duodenum may be demonstrable, which, however, invariably passes on to a paralytic stasis of varying degree.

The origin of the excretory block is still open to discussion, regarding whether it is caused by direct cell damage or by way of the sympathetic nervous system.

Nervous Excretory Origin of Jaundice:—No details are available pertaining to the existence of a nervous regulation of the excretory function of the liver cells. However, as pointed out by Frerich, since the nervous control of the secretion of the liver cells was established by Claude Bernard, the idea of a nervous excretory block as a cause of jaundice should not seem extraordinary.

The observation of a sudden release of excretory block upon manipulation of the common duct has been further confirmed by the experiments of Dick, who demonstrated that the obstruction of bile drainage in acute hepatitis could be re-

leased by the injection of 0.5 per cent novocain solution paravertebrally between D11 and D12.

The theory of a common disturbance of nervous regulation has also been supported by more recent observations. H. Brocard was able to produce an experimental hepatitis in a considerable percentage of cases, by injections of minute quantities of an oily solution of phosphorus and alcohol into the right or left splanchnic nerve. Proof that the lesion in the liver was actually caused by the damage to the splanchnic nerve was established by the fact that injections of the same substances in other locations, and even in larger quantities, did not produce similar changes in the liver. It is a remarkable fact that although larger quantities were capable of destroying the splanchnic nerve, they produced no greater pathologic changes in the liver than were produced by the small injections.

The pathologic changes in the liver were classified by Brocard as:

1. dilatation of the capillary veins (observed in one-third of the cases).
2. hyperplasia of the reticuloendothelial, *i.e.*, Kupfer cells.
3. pathologic changes in the liver cells:
   (a) fatty degeneration
   (b) cytolysis
   (c) pyknosis
   (d) insular necrosis
4. proliferation of the fibrous tissue.

In some cases, edema, vascular stasis and changes in the reticuloendothelial system are especially pronounced. Yet jaundice could not be observed in Brocard's experiments. However, the most interesting fact remains, namely, that damage to the liver cells could be produced by damage to the splanchnic nerve.

In trying to correlate these experimental findings with the clinical conception of epidemic hepatitis, it is necessary to keep in mind that *the infective virus in some cases shows definite neurotropic properties*. Considering that in some instances the infective or toxic agent might cause some damage to the splanchnic nerve, as well as direct damage to the liver cell, it can readily be realized that we have to deal, not only with the effect of inflammatory changes in the liver, but also with a general dyskinesia of the entire extrahepatic duct system, including the duodenum. No other conception could account for the participation of the duodenum in cases of hepatitis. It should also be kept in mind that, even in serum hepatitis, in which the infection is caused by parenteral injection, involvement of the duodenum has been noted in several instances.

Conclusions

The following theory of the pathogenesis of jaundice is presented:

1. The main pathological feature in hepatojaundice is a partial or complete excretory block within the liver cells, while the formation of hepatorubin goes on almost undiminished. The liver cell enlarges and shows actual signs of hyperactivity (multiple mitosis). Bile pigment, instead of being excreted in a normal way into the

bile capillaries, is reabsorbed by the lymphatics and blood capillaries. Cell necrosis is an independent process.

2. This excretory block is associated with a toxic paralysis of the whole cholokinetic bile duct system, including the gallbladder.

3. Toxic paralysis also involves the second part of the duodenum.

4. The frequent painless duodenal ulcers suggest a neurotropic nature.

5. The cause of this whole pathological complex probably lies in a toxic damage of the hepatic branch and some duodenal branches of the splanchnic nerves or the nerve centers.

6. It is possible that a neurotoxic virus strain or other toxins might be the etiologic agent.

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GASTRIC ANALYSIS — PRACTICAL OR USELESS?

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In recent years gastric analysis has been under criticism as a procedure which is time consuming and which affords few results helpful in either a diagnostic or prognostic way. It has therefore been argued by some that this procedure be abandoned.

A survey of current medical literature, however, reveals comparatively few good arguments against gastric analysis, while it shows numerous valid reasons, and one facetious one in favor of the operation.

Arguments Against Gastric Analysis

1. The variations in the constituents of the gastric juice from day to day are so great as to make any one analysis unreliable. Gastric analysis cannot, therefore, be trusted from a statistical standpoint.

2. Gastric analysis and cytodiagnosis are time consuming, difficult, and often productive of ambiguous results.

3. In many cases neither the prognosis nor the treatment will be influenced by the results of the gastric analysis.

4. Gastric analysis will not demonstrate organic disease.

Arguments in Favor of Gastric Analysis

1. It is a means of obtaining material for cytodiagnosis.

2. It is useful in cases of histamine proven anacidity in a gastric ulcer where anatomical methods could not differentiate its benign or malignant character.

3. It is a useful differential diagnostic aid in pernicious or macrocytic idiopathic anemia.

4. It is helpful in cases of duodenal or gastrojejunal ulcer in which the presence of the lesion or its activity must be determined.

5. It may be used to determine the effect of treatment of the aforesaid ulcers.

6. The presence of abnormalities of acid, while they may be due to functional and/or temporary causes, may also be suggestive of organic diseases.

7. It may be used to assist in determining the relationship between achlorhydria and/or hypochlorhydria, and the acute enteritides and parasitic infestations, especially amebiasis.

8. It is a procedure for the recovery of tubercle bacilli from the stomach.

9. It is helpful in the study of acidity following gastric resection, which factor is of unquestioned value in estimating the likelihood of recurrence.

10. It makes a contribution to the sum total knowledge of ulcer as well as other types of gastric disease, and gastric physiology.

11. Some authors claim that heavy diagnostic odds for or against the benign or malignant character of certain stomach lesions may be deduced from a gastric analysis.

12. One writer feels that its performance functions only as a diversion.

Time and space do not permit enlarging upon each of these topics, but we do want to point out in the very beginning that whatever gastric analysis may or may not be, it is *not* time consuming. No hospital is conducted with such ideal efficiency that in the course of a gastrointestinal survey the patient does not have one free morning during which a gastric analysis might be performed. If it is not considered time consuming to do a gastrointestinal x-ray series, why is it time consuming to do a gastric analysis?

It is the purpose of this paper to study the gastric analysis in 100 cases, in each of which the analysis was properly performed together with an x-ray study and a gastroscopic examination. In this way we are better able to determine the status of the gastric analysis in these cases since the x-ray and gastroscopic examinations serve as a very real check upon the intragastric situation. In addition, several of these cases reached the operating or autopsy table, and their tissues passed under the pathologist's microscope, so that the check on the original condition at the time of the diagnostic study is even more rigid. As a result of such a study we should be able to finally reach some conclusion about the usefulness of gastric analysis, at least in the specific cases studied.

Since there is such a marked feeling today that gastric analysis has failed and has entered a state of disrepute, there should be no objection to asking *why*, and to exposing the sad state of ignorance which surrounds gastric analysis both in the doing and in the interpretation thereof.

First of all gastric analysis has lost favor because of the utterly erroneous belief originally held in the early days that it was the single diagnostic procedure necessary—the *sine qua non*—of gastric diagnosis. From this fallacy the pendulum of medical thought seems to have swung to the opposite and equally fallacious extreme —that it is utterly worthless. Perhaps neither is correct. Gastric analysis is merely one piece in the diagnostic puzzle, and as in any puzzle, it may be a trivial piece or a highly important one.

Secondly, there is no accepted, standard procedure in existence today upon which uniform, reliable, normal values may be established. Each investigator, scientific and serious minded though he may be, feels that his method, his technic, is not merely the best, but the only adequate way of dealing with the subject. As a result, we have today too many types of test meals and too many technics. The following list represents some of the methods in use at present:

Bread and water test meal.
Bread and tea test meal.
Arrowroot cookies and tea test meal.
Seven per cent alcohol test meal.
Bouillon test meal.
Cereal gruel test meal.
Histamine technic.
Double histamine technic.
Insulin technic.
Acidity reduction test.
Dilution indicator test.
Neutral red test.
Urinary reaction test.

These tests are not uniform in their purpose, and as far as can be determined, no complete and reliable study has ever put forth the truly normal findings to be expected with each method. It is not logical to expect that a stomach would give, let us say, the identical acid values with a bread and water test meal, and alcohol test meal, or a histamine injection. What is the normal result from each of the above methods? Are they alike? If not, how do they differ, and why?

In many instances the dosages and procedures are not clear to the person conducting the analysis. Let us take histamine as an example. The dose of histamine for the purposes of gastric analysis is one-tenth milligram per ten kilos of body weight. The usual dose will thus range between 0.25 mg. to 1.0 mg. Furthermore, this histamine should be fresh and potent. It should cause flushing of the face, a slight transitory diminution in the systolic blood pressure and at times an uncomfortable sensation in the head, even a mild headache. If these do not occur, or if flushing is not noted in a member of the white race after histamine injection, that particular histamine is not potent and the subsequent gastric response is therefore unreliable. Furthermore, histamine is used to determine whether or not the gastric mucosa is capable of secreting hydrochloric acid.

All these things are of an elementary nature, yet how often is a tube passed, the fasting gastric contents extracted, and ½ c.c. of histamine preparation injected without ever weighing the patient and calculating his required dosage? Indeed, this is done without ever waiting to see whether or not the stomach is capable of secreting hydrochloric acid on its own, so that one never knows whether the mucosa produced acid by itself or only after having been whipped up by a dose of histamine which may have been unnecessary, too large or inadequate. We have yet to see an operator of the above variety wait for face flushing or take a blood pressure determination before proceeding with the analysis.

Obviously the result of such an analysis is not only confusing, but worthless.

Thirdly, there is often a failure to consider the reason for which the gastric analysis is being performed. In a patient whose stomach has produced no free hydrochloric acid on a bread and water test meal, and who has a suspicious primary anemia and/or signs of spinal cord degeneration—histamine is indicated. To determine the postvagectomy status an insulin test is used by many. For certain technical physiological research more refined methods are needed; but to tube a patient, pour down any type of test meal or indiscriminately to inject him with the product discussed in the scientific article read last evening is not the way to do gastric analysis.

Fourthly, gastric analysis has failed because of the confusion in the medical mind between such things as environmental and neuropsychiatric factors, and truly organic types of disease. It is readily admitted that acidity, secretion rate and quantity, and gastric emptying may be readily influenced by all of the above factors, but it takes some "Neuro" to put occult blood in his stomach, exfoliate his gastric cells, fill up with "coffee ground" material, or produce tubercle bacilli in the gastric washings by just sitting and worrying. Let us try to think what it is we want or expect from a gastric analysis before we condemn it as worthless.

Finally, gastric analysis has lost favor because of the failure to appreciate the fact that there is vastly more to the procedure than the mere determination of the presence or absence of hydrochloric acid and its highest value when present. Too much emphasis has been placed upon acid values, which again is only one piece in the puzzle of the gastric analysis. It is making one, single, solitary fact in the analysis the whole analysis, and this is neither logical nor sensible. It must be remembered at all times that the type of acid secretory curve is more important than the finding of one or two so-called hyperacidity values, and that as there are tall and short people, so there are high normal acid secretory curves and low ones. It is the contour of the curve which is normal or abnormal regardless of the acid values. The entire digestive cycle should and must be viewed as a whole, and not one acid value seized upon for comment.

All these things result from the failure to understand how to perform and interpret a gastric analysis and to comprehend what it really is. Balanced thinking based upon real knowledge and background is needed in place of unbounded zeal based merely upon reading an article, however good that article may have been.

After such comments it is only fair to attempt to explain just what constitutes a gastric analysis and what results may be expected from it.

When correctly performed, upon a patient properly prepared, and when subsequently intelligently interpreted, gastric analysis is merely one step in the diagnostic survey, but it is presumed to be an important step and one which is assumed to cover considerable organic territory, and to yield extensive information. It must be kept in mind that the findings in a gastric analysis are not necessarily entirely gastric in origin. Extragastric pathology is manifested not only indirectly by its reflex effect upon the acid secretory curve, but directly by the findings (at times) of products of extragastric pathology which have been added to the gastric contents as a result of having been swallowed from above or regurgitated from lower but adjacent levels of the gastrointestinal tract; swallowed pus from a discharging sinus; regurgitated duodenal epithelium, etc.

Intragastric pathology is manifested by finding the products of that pathology as an integral part of the aspirated gastric juice—exfoliated gastric epithelium, mucus, bacterial colonies, etc.

In addition, gastric analysis is a measure of gastric work in the fasting and digestive stages, and in the motor and secretory phases of those stages. This is why one should be thoroughly familiar with the results to be expected normally with the type of test meal, etc., being used, since that test meal, etc., represents a standard load or condition under which the stomach must perform its work. Thus we are able to measure the physiological functions of the stomach (at that particular analysis), acid secretion, motor activity, etc., and so arrive at some conclusions as to the immediate status of the organ.

Finally we must mention the free hydrochloric acid.

While it is not precisely accurate to say that the estimation of the acid values is perhaps the least important factor in gastric analysis, still it is perfectly correct

to say that ofttimes entirely too much stress is put upon the acid values alone, to the exclusion of many other findings of equal and sometimes greater importance. Time and again analyses are performed where the sole substance tested for is hydrochloric acid, and never a drop of juice put on a slide and passed beneath the objective of a microscope. It would seem just as logical to test the pH of the urine and to try to make some diagnostic assumption on that one finding alone.

As Rehfuss, Hawk, et al., showed conclusively, the type of so-called normal curve of gastric acidity cannot be standardized for all people, just as, obviously, all people cannot be standardized. It is vital to know whether or not free hydrochloric acid is present, and, if absent, whether there is a histamine anacidity; but it is neither vital nor sensible to quibble about the normalcy of a stomach whose free hydrochloric acid is at one time 40 and at another time 50 clinical units.

The fractional method is the only logical method to be applied to gastric analysis (in the usual sense). It is simple, and it gives the investigator information at all times. Errors of secretion and motility; rapidity of chymification; duodenal reflux and its timing; the appearance of frank or occult bleeding; the obtaining of both fasting and digesting residues; etc.; are all covered by the fractional method. However, to put down a tube, extract the fasting contents, withdraw the tube, give some type of test meal or gastric stimulant, and to repeat the tubing and withdrawal one hour later can hardly be called a gastric analysis. If the fractional method, properly performed, has fallen into disrepute, this latter method does not even warrant discussion.

Methods Used in the Cases Studied and the Criteria Upon Which They Are Evaluated

All cases in this study had a complete gastrointestinal x-ray series and, if warranted, other related x-ray studies. All cases were gastroscoped and the findings carefully noted.

The gastric analysis in each case was performed using a test meal of 50 grams of white, unbuttered bread from which the crust had been removed and 250 c.c. of water. Fractions were extracted every 30 minutes *until the stomach was empty* or until the tube had to be removed for some valid reason, such as the appearance of gross blood, or severe vomiting. All cases which showed an anacidity were subsequently reexamined using fresh, potent histamine in a dose of 0.1 mg. per 10 kilos of body weight as a stimulus.

What are the normal findings in a gastric analysis of this type?

For the purposes of this paper the following criteria will be considered indicative of normal results.

Fasting Gastric Contents.

Amount:—Up to 50 c.c. is the ideal amount; 50-75 c.c. may be considered as suspicious, but anything over this value is definitely abnormal and may be due to such factors as hypersecretion, pyloric obstruction, duodenobiliary reflux, etc.

Sediment:—Five per cent or less of the total amount recovered.

Odor:—A pungent, penetrating, not unpleasant, characteristic odor familiar to all who do work along gastric lines.

Appearance:—White to pearly grey with no food residue, of a rather watery consistency with very small amounts of mucus. Floating mucus, if present, is to be considered as swallowed and its origin should be sought at higher levels; mixed mucus is of gastric origin.

Authorities differ on the subject of biliary regurgitation, some claiming that it may exist in as high as 50 per cent of the cases tested, and others that it is to be expected in only one case out of five. It is important to know how the patient took the tube, since gagging, retching, etc., while swallowing the tube may cause bile to regurgitate into the stomach.

Occult Blood:—When positive in the fasting stomach only, this is not to be taken too seriously, since it is usually extragastric in origin, due to disease at higher levels, trauma to the gums as in brushing the teeth, trauma from the passage of the tube, etc. The quantity, and the number of times that occult blood appears during the analysis, especially if it increases toward the end of the analysis, are more important than its mere presence in the fasting contents.

Acid Values:—Twenty-five clinical units of free hydrochloric acid or less; 35 clinical units of total acidity or less. Over 25 units of free hydrochloric acid in the fasting stomach must be considered as hypernormal and the possible causes investigated.

It must be remembered that these values are approximate ones and will vary widely within normal limits. There may be high or low figures within the normal range, which figures are often related to body habitus and vital function, although, as we have stated above, the acid secretory curve is ultimately of more importance than any one isolated acid value.

Microscopy:—The question of the microscopy of the fasting gastric contents is a matter of relative values, for should one search long enough, the findings may be boundless. This is no drawback in the case of urinary microscopy and it should not be one to the microscopy of gastric contents.

In general, the less one finds, grossly or microscopically, in the fasting stomach, the more normal that stomach may be considered, other factors being equal.

Food Residue:—Zero to minimal amounts.

Mucus:—The types described above in very small amounts.

Epithelium:—Oral and respiratory very few; esophageal and gastric few, in keeping with the normal rate of exfoliation of the cells of the mucosa; duodenal epithelium few to absent under normal conditions.

Salivary Corpuscles:—Few.

Blood Cells:—Leucocytes very few.

Erythrocytes minimal to absent. (See remarks under occult blood).

Bacteria:—They may be numerous, but they occur singly or in scattered masses, never in colonies.

Bile Salts and Crystals:—Minimal to absent.

Gastric Secretory Curves:—The so-called *normal gastric secretory curve* is one which reaches its peak in from 60 to 75 minutes after the ingestion of the test meal and which in 120 minutes has dropped to within 10 to 15 clinical units above the initial fasting acid values.

It must be kept in mind that it is the curve which is normal, and not any one figure upon which the curve is plotted. Hence there may be a normal type of curve with high, low or medium acid values.

In the *extragastric curve* the line rises steadily from the beginning to the end of the analysis, or it may level off and give the so-called "Plateau Formation". At any rate it shows no tendency to drop towards the base line as does the normal curve.

The *delayed digestion curve* shows a primary rise in the acid values followed by a drop which is then succeeded by a practically normal type of curve.

The *stepladder curve* shows a smooth ascent broken by abrupt declines in acid values, which declines are not associated with duodenobiliary regurgitation.

The *achylic curve* is the one found in achlorhydria, and it is merely a line which coincides with the base line indicating a value of zero for the free hydrochloric acid.

Gradations for Free Hydrochloric Acid:—The normal range for acid values during the analysis is variable, but, in general, the free hydrochloric acid varies between 30 to 50 clinical units in both sexes, falling off in the years from 55 to 60 and onwards.

Any stomach which is capable of secreting 20 or more clinical units of free hydrochloric acid after the test meal noted above must be placed in the normal group, if it complies with all the other qualifications. After histamine stimulation such a stomach may secrete maximal amounts of free acid.

Bockus gives the following limits for the various grades of hyperacidity:

50-59 clinical units of free HCl—Grade I Hyperacidity.

60-84 clinical units of free HCl—Grade II Hyperacidity.

85-99 clinical units of free HCl—Grade III Hyperacidity.

100 and over clinical units of free HCl—Grade IV Hyperacidity.

Achlorhydria is considered to indicate the absence of free hydrochloric acid.

True achlorhydria is said to exist when free hydrochloric acid is absent after an adequate histamine stimulation.

Motor End Point:—The normally functioning stomach will empty the bread and water test meal in from 2 to 2½ hours; the roentgenologist's barium meal in from 4 to 6 hours; and the average normal full meal in about the same time.

Chymification:—This is the normal stomach's ability to take all ingesta and to reduce them to a substance of homogeneous, semifluid consistency known as chyme.

It is upon these findings and upon numerous others, so obviously abnormal as to require no specific comment here, that the discussion of the cases is based.

In order to be as fair and unbiased as possible we shall try to present cases showing both sides of the problem. Specifically, we are attempting to answer the

following question: If a doctor did not have available any x-ray and gastroscopic studies, would he be justified in diagnosing and treating a given case solely upon the findings of a properly performed fractional gastric analysis? Or, in other words, is there any reliability to be placed on gastric analysis either for diagnostic, therapeutic or prognostic purposes?

We have grouped our cases into two general classes—those with significant and those with nonsignificant gastric analyses.

A significant gastric analysis is one which of itself points to some definite derangement of the stomach of an organic or functional nature, or both. It is the type of an analysis which would of itself warrant or demand further study of the stomach in an effort to determine the actual reason for such abnormal findings. (Histamine anacidity, evidence of gastric retention, etc.)

In this series a significant gastric analysis must not be construed as one in which the abnormal findings are pathognomonic or diagnostically suggestive of any given gastric pathology, but merely as one which is grossly abnormal in its findings.

It would be unscientific and foolhardy to imply that each intragastric condition has its own typical, tell-tale gastric analysis, for such is very definitely not the case. We simply mean by the term "significant" that the findings deviate sufficiently from the accepted criteria of normalcy as to call attention to the stomach in preference to other parts of the gastroenteron so as to demand further study of that organ.

A nonsignificant gastric analysis is one in which the findings are not suggestive of any possible diagnosis when considered alone, nor do they seem to have any bearing on the subsequent findings at x-ray and gastroscopy. However, this does not mean that the findings in a nonsignificant gastric analysis (as the term is used in this paper) are to be interpreted as ideally normal.

As a matter of fact, very few ideally normal gastric analyses were present in this series; yet, strange to say, some of them occurred in cases showing roentgen and gastroscopic evidence of true intragastric pathology.

This is in itself very important since we have the actual fact of a stomach bearing the stigma of a pathological diagnosis, which by way of the gastric tube is still showing no signs of that diagnosis in the way in which it performs its work as gauged by gastric analysis.

The question remains and must some day be answered as to how much organic or functional change a stomach is capable of sustaining before giving rise to significant findings in the gastric analysis and, on the other hand, we must try to learn why some stomachs, having definite organic or functional change, produce normal findings upon gastric analysis, while stomachs with very much less pathology give such dramatically abnormal findings.

Perhaps our discontent with gastric analysis arises from our own ignorance. Regardless of the opinion one may have of the procedure it reveals only what is in the stomach at that particular time, just as a camera photographs only what is

before it. In the latter case we may like or dislike the picture, but it is hardly the fault of the camera or film, if all these things have been properly used.

So it is with gastric analysis. When the above questions have been adequately and satisfactorily answered in a way which can be demonstrated and proven to be dependable, the stomach will be a vastly more familiar organ than it is today in spite of the many achievements in the study of its functions and diseases. The gastric tube drains what it finds in the stomach at any given time. Is it sound reasoning to put the blame upon gastric analysis because we have insufficient knowledge at present to interpret the findings thus derived?

TABLE I

Diagnosis	Total number of times diagnosis made	Gastric Analysis	
		Significant	Nonsignificant
Atrophic Gastritis	24	12	12
Superficial Gastritis	45	23	22
Hypertrophic Gastritis	18	8	10
Gastritis of the postoperative stomach	8	5	3
Gastritis of indeterminate type	4	1	3
Gastritis, subacute	1	1	0
Hemorrhagic Erosions	8	3	5
Mucosal Hyperemia	1	0	1
Submucosal Hemorrhage	14	5	9
Mucosal Ulcer	1	1	0
Varicosity of Gastric Vessels	1	0	1
Duodenal Ulcer	21	16	5
Gastric Ulcer	14	6	8
Marginal Ulcer	1	1	0
Jejunal Ulcer	1	1	0
Pyloric Stenosis	16	12	4
Pylorospasm	2	1	1
Distorted Pylorus	2	1	1
Gastrospasm	1	1	0
Pseudopolyps	1	1	0
Hypersecretion	2	2	0
Hiatus Hernia	1	0	1
Gastric Polyps	1	0	1
Gastric Carcinoma—Type IV	14	8	6
Gastric Carcinoma—Type III	1	1	0
Ulcerating Lesion at Cardia	1	1	0
Extragastric Tumor	2	0	2
Indeterminate Lesion	2	1	1
Jejunitis	1	1	0

In this series of 100 cases there were 60 males and 40 females. The males ranged from 23 to 83 years with an average age of 53.7 years. The females ranged from 12 to 77 years with an average age of 51.0 years. Further subdivision shows 52 cases with a "significant" gastric analysis and 48 with a "nonsignificant" one. Of the 52 cases having a significant analysis there were 30 males (ages 23 to 69 years; average 51.6 years) and 22 females (ages 18 to 67 years; average 50.0 years). Of the 48 cases having a nonsignificant analysis there were 30 males (ages 27 to 83 years; average 55.6 years) and 18 females (ages 12 to 77 years; average 52.3 years).

A total of 209 diagnoses were made in the 100 cases studied (Table I).

It is obvious from the above that very often there was more than one diagnosis made in most of the stomachs examined. This is a common finding and one familiar to all gastroscopists, although it grossly complicates the study since we are

not able to present a gastric analysis as representing the stomach suffering from only one type of pathology. Indeed, this may well be one of the reasons for the reputed unreliability of gastric analysis.

Each case was carefully studied and the conclusion finally reached that the location of the pathology within the stomach had nothing to do with the gastric analysis findings except in cases of pyloric obstruction.

In the 52 cases showing a significant gastric analysis, the x-ray and gastroscopic diagnoses were in agreement in 88.5 per cent (46 cases), and differed in 11.5 per cent (6 cases). In the 48 cases showing a nonsignificant gastric analysis, the x-ray and gastroscopic diagnoses were in agreement in 79.2 per cent (38 cases) and differed in 20.8 per cent (10 cases).

These findings have been adjusted to take into account the presence or absence of the familiar forms of gastritis which, with all due respect to roentgenology, cannot at the present time be diagnosed by x-ray study. The only accurate method of diagnosing gastritis up to this time is through the gastroscope and/or beneath the microscope, the latter method being the surest.

Examples of cases with significant and nonsignificant gastric analyses will now be presented as they occurred in cases with the following diagnoses:

Atrophic Gastritis.	Gastric Ulcer.
Superficial Gastritis.	Gastric Carcinoma.
Hypertrophic Gastritis.	Pyloric Stenosis.
Postoperative Gastritis.	Duodenal Ulcer.

Under each of these headings a "significant" and a "nonsignificant" case will be presented, contrasted and discussed. In this way we may attempt to evaluate whether or not gastric analysis is of any significance whatsoever. This procedure was carried out for all the cases studied, but space permits only an exposition of one example of each type.

Atrophic Gastritis

Significant Analysis:—Female:—Aged 62 with pain over the left side of the abdomen extending into the lower abdomen and back; sharp and cramp-like in character and of three years duration. No relation to meals.

Stools:—Negative for occult blood.

X-ray:—Ptosis of the gastrointestinal tract and irritable colon; otherwise negative.

Fractional Gastric Analysis:—

Last meal 15½ hours before.	Duodenal epithelium plus.				
Fasting contents 12 c.c.	W.B.C. as pus plus.				
Slightly bile stained.	R.B.C. few.				
Food residue plus.	Bile salts plus.				
Mucous strands plus.	Took tube well.				
Gastric epithelium plus.					
Total Acidity	10	15	15	10	10
Free Hydrochloric Acid.	0	0	0	0	0

This is an achylic type of curve with the stomach emptying in 2 hours. The final specimen showed no gross bile or mucus; absent rennet; lactic acid a trace; occult blood negative.

Microscopy of the final (2 hr.) specimen revealed:—

Bile salts plus.	Duodenal epithelium few.
Mucus plus.	Pus few.
Squamous epithelium few.	Cholesterol crystals few.

Three days later the same case was again tested with a suitable dose of histamine. There were similar findings to the above with anacidity.

Gastroscopic Diagnosis:—Atrophic gastritis—advanced.

Nonsignificant Analysis:—Female:—Aged 75, with severe epigastric pain, but not of the ulcer type; worse by food and accompanied by bloating. Constipation with mucus in the stools. Six attacks of coffee ground vomitus, and a loss of 50 pounds in the last 15 months. Prior to this there had been malaise, weakness and fatigue.

Stools:—Negative for occult blood.

X-ray:—First degree ptosis of the stomach with an ulcer on the greater curvature in the prepyloric area. Diverticulosis of the colon.

Fractional Gastric Analysis:—

Fasting contents 15 c.c.	Gastric epithelium plus.				
Food residue none.	Salivary corpuscles 2 plus.				
Mucus mixed plus.	Pus plus.				
Mucous strands few.	Yeasts few.				
Respiratory, oral epithelium plus.	Took tube well.				
Total Acidity.	11	36	39	52	64
Free Hydrochloric Acid.	0	16	19	32	44
Mucus.	+	±	±	—	—

This is an extragastric type of curve with the stomach emptying in 2 hours. The final specimen showed mucus and occult blood to be negative; rennet present.

Microscopy of the final (2 hr.) specimen revealed:—

Undigested food plus.	Fat globules few.
Mucus strands plus or minus.	Pus plus.
R.B.C. few.	

Gastroscopic Diagnosis:—Atrophic gastritis; varicose gastric vessels; probable gastric ulcer.

Discussion:—In the significant case the anacidity on the test meal and histamine; the absence of rennet and the minimal findings microscopically are characteristic and to be expected in atrophic gastritis.

In the nonsignificant case with findings in the fasting stomach comparable to those of the significant case, but with its perfectly normal range of free hydrochloric acid considering the patient's age and sex, and the presence of rennet, we would not

think of atrophic gastritis. We might fit this into the diagnostic picture of a peptic ulcer or a carcinoma in an aged woman, but without x-ray and gastroscopy this would have again been misleading because the acid secretory curve is decidedly extragastric.

Hence it is difficult to fit this analysis into either an atrophic gastritis, a gastric ulcer, or a carcinoma, so it becomes not only useless in the diagnostic summary, but altogether misleading had sole reliance been placed upon it.

Superficial Gastritis

Significant Analysis:—Male:—Aged 32, with so-called stomach pain and backache for 5 months. The pain occurred 15 - 20 minutes after meals. There was poor appetite, sour taste in the mouth, loss of 25 pounds in 5 weeks and constipation.

Stools:—Showed a trace of occult blood.

X-ray:—Stomach normal; duodenal ulcer.

Fractional Gastric Analysis:—

Last meal 14½ hours before.				Gastric epithelium 3 plus.			
Fasting contents 55 c.c.				Duodenal epithelium plus.			
Appearance mucoid.				R.B.C. few.			
Mucus floating plus.				W.B.C. plus.			
Mucus mixed 2 plus.				Pus 2 plus.			
Mucous strands plus.				Took tube fair.			
Total Acidity.	12	16	32	34	22	24	24
Free Hydrochloric Acid.	0	6	16	22	12	14	18

This curve is not typical of any of the types mentioned. The stomach emptied at 3 hours. Occult blood was negative.

Microscopy of the final (3 hr.) specimen revealed:—

Undigested food 3 plus.	Red mucus occasional.
Mucus threads plus.	Yeasts 2 plus.

Gastroscopic Diagnosis:—Superficial gastritis — marked.

Nonsignificant Analysis:—Male:—aged 57, with epigastric pain and a sensation as if there were a weight or lump in that region. Some weight loss.

Stools:—Were negative for occult blood.

X-ray:—There was no evidence of any intrinsic gastrointestinal lesion.

Fractional Gastric Analysis:—

Fasting contents 15 c.c.				Salivary corpuscles few.			
Bile stained.				Bile salts few.			
Oral epithelium few.				Bacteria few.			
Duodenal epithelium few.				Took tube badly.			
Total Acidity.	20	15	18	12	14	15	Q.N.S.
Free Hydrochloric Acid.	0	0	0	0	0	0	Q.N.S.
Bile.	+	Tr.	Ft.Tr.	Ft.Tr	—	—	—
Mucus.	Tr	Tr	Tr	Tr	+	+	+

This is an achylic type of curve with the stomach emptying in 2 hours. At the end of the first hour a dose of histamine was given, but still no free hydrochloric

acid was obtained up to the time the stomach emptied. Occult blood was negative.

Microscopy of the final (2 hr.) specimen revealed:—

Fat globules few.	Oral epithelium few.
Pus few.	Bile salts few.

Gastroscopic Diagnosis:—Submucosal hemorrhage; superficial gastritis.

Discussion:—The significant case shows mucus both grossly and microscopically, gastric exfoliation, low acidity and a few food rests; on the other hand the nonsignificant case showed very little mucus, no gastric exfoliation, anacidity and histamine anacidity—a situation one would expect to find in atrophic gastritis.

Hypertrophic Gastritis

Significant Analysis:—*Male:*—Aged 40, with severe epigastric pain, distress and burning relieved occasionally by alkalis. Duration 4 years. Few attacks of vomiting 1-1½ hrs. afer meals. Good appetite and no weight loss.

Stools:—Negative for occult blood.

X-ray:—Rugae moderately exaggerated between the cardia and the pars media. Diagnosis made of hypermotility with otherwise negative findings (except the rugae).

Fractional Gastric Analysis:—

Last meal 14 hrs. before.	Oral epithelium few.
Fasting contents 121 c.c.	Gastric epithelium plus.
Bile stained and mucoid.	Duodenal epithelium plus.
Food residue trace.	W.B.C. plus.
Mucus floating 2 plus.	Bile salts 2 plus.
Mucus mixed plus.	Bacteria few.
Mucous strands plus.	Took tube well.
Free fats few.	

Total Acidity.	18	22	28	26	30	32	28	22	30
Free Hydrochloric Acid.	8	10	18	12	18	18	16	14	16
Bile.	+	Tr	—	—	Tr	+	+	+	+

This curve is not typical of any of the types mentioned. The stomach took 4 hours to empty. Occult blood was negative.

Microscopy of the final (4 hr.) specimen revealed:

Undigested food 3 plus.	Mucous threads plus.
Yeast cells 2 plus.	Bacteria plus.
Free fats plus.	Bile salts plus.

Gastroscopic Diagnosis:—Hypertrophic gastritis; hypersecretion.

Nonsignificant Analysis:—*Female:*—Aged 45, with pain in the right lumbar region of 8 yrs. duration. Worse at night. No other symptoms.

Stools:—Negative for occult blood.

X-ray:—Gastric atony and ptosis.

Fractional Gastric Analysis:—

Fasting contents 10 c.c.	Bile salts few.				
Mucoid.	Took tube well.				
Mucus mixed plus.					
Total Acidity.	22	35	57	55	46
Free Hydrochloric Acid.	12	25	41	41	26
Bile.	—	Tr	Tr	Tr	Tr

This is a curve which closely resembles the normal one with the stomach emptying in 2 hours. Occult blood was negative.

Microscopy of the final (2 hr.) specimen revealed:—

Bile salts few. Fat globules few.

Gastroscopic Diagnosis:—Hypertrophic gastritis.

Discussion:—While the significant analysis is not pathognomonic of hypertrophic gastritis (and we know of no analysis which is), nevertheless, it is not a normal analysis: mucus, epithelium, low acid values, 4 hr. emptying time, etc.

The nonsignificant analysis is, on the other hand, a practically normal gastric analysis, and would not make anyone suspect the pathology noted at gastroscopy.

POSTOPERATIVE GASTRITIS

Significant Analysis:—Male:—Aged 37, with midline upper abdominal distress, burning in character; no relief from any type of therapy. Gastric resection for duodenal ulcer in 1942. Worse ever since (2 yrs.).

Stools:—Negative for occult blood.

X-ray:—Negative findings considering the resection.

Fractional Gastric Analysis:—

Last meal 15 hours before.	Duodenal epithelium plus.				
Fasting contents 15 c.c.	Mucous strands few.				
Dark brown color.	Pus few.				
Bile 4 plus.	Took tube well.				
Total Acidity.	20	29	17	16	6
Free Hydrochloric Acid.	0	0	0	0	0
Bile.	4 plus in all the fractions.				

This is an achylic type of curve with the stomach emptying in 2 hours.

Microscopy of the final (2 hr.) specimen revealed:—

Undigested food 3 plus. Yeast cells few.

Duodenal cells few. Pus 2 plus.

Bile salts few.

A fractional gastric analysis with histamine was performed the next day with the following results. The findings in the fasting stomach were essentially the same as those given above.

Total Acidity.	22	24	36	45	44	22	20
Free Hydrochloric Acid.	0	0	0	25	24	10	8
Bile.	Large amounts throughout the analysis.						

Except for the delay in the acid secretion this is a practically normal type of curve with the stomach emptying in 3 hours.

Microscopy of the final (3 hrs) specimen revealed:—

Pus 3 plus.	Yeasts few.
Mucous strands few.	Gastric epithelium plus.

Gastroscopic Diagnosis:—Postoperative gastritis in the portion of the stomach remaining after resection.

Nonsignificant Analysis:—*Male:*—Aged 52, with belching and sharp pain in the right side of the abdomen. Black, tarry stool; loss of 17 pounds in the past year.

Stools:—Were 4 plus positive for occult blood on 6 occasions; 3 plus positive once; negative 8 times.

X-ray:—Second degree ptosis; gastric enlargement; pyloric stenosis; gastroenterostomy.

Fractional Gastric Analysis:—

Fasting contents 47 c.c.	Bile salts 2 plus.
Bile 3 plus.	Crystals plus or minus.
Mucus floating plus or minus.	Free fats 2 plus.
Mucus mixed plus or minus.	Took tube well.
Mucous strands plus or minus.	Gastric epithelium plus, minus.
Duodenal epithelium plus, minus.	

Total Acidity.	14	62	54	40	62	46	25
Free Hydrochloric Acid.	0	46	44	28	52	36	20
Bile.	+++	+	±	++	±	++	+

This curve is not typical of any of the types mentioned, but shows a grade one hyperacidity. The stomach emptied in 3 hours. Occult blood was negative.

Microscopy of the final (3 hr.) specimen revealed:—

Undigested food plus.	Calcium bilirubinate pigment few.
Bile salts 2 plus.	Cholesterol crystals few.
Mucous strands few.	Yeast cells 2 plus.

Gastroscopic Diagnosis:—Postoperative gastritis in a stomach following gastroenterostomy.

Discussion:—Perhaps these two cases are not comparable in that one is a resected stomach and one a stomach upon which gastroenterostomy has been performed. Yet we have another case of gastroenterostomy in the series where the stomach showed a more rapid emptying time, but a histamine anacidity.

The anacidity in the significant case speaks well for the resection, yet the patient suffered from a different disease after surgery than before. The histamine stimulation did produce acid, so all the acid-bearing area of the stomach had not been removed. However, anacidity, pus, reflux of bile, and the history should be very suggestive of postoperative gastritis.

The nonsignificant case showed bleeding, reflux of bile, delayed emptying, and reached a grade I value for hyperacidity. This would not be expected in a normally functioning gastroenterostomy.

Since one case had no free hydrochloric acid and the other reached a grade I hyperacidity, and since one stomach emptied in 2 hours and the other in 3

hours, the cause of postoperative gastritis must be due to some other factor than acid and/or emptying.

Gastric Ulcer

Significant Analysis:—Female:—Aged 62, with pain in the upper right and left quadrants of the abdomen for one week, but not related to meals. Nausea for two weeks. Poor appetite; constipation; loss of 17 pounds in two weeks.

Stools:—Positive 2 plus for occult blood.

X-ray:—Ulcerating lesion on the lesser curvature of the stomach 15 x 5 mm.

Fractional Gastric Analysis:—

Last meal 12 hrs. before.	Duodenal epithelium few.
Fasting contents 30 c.c.	W.B.C. too numerous to count.
Mucoid appearance.	Pus few.
Mucus mixed 4 plus.	Took tube well.
Mucous strands few.	

Total Acidity.	20	36	45	66	65	43
Free Hydrochloric Acid.	0	26	35	50	46	31

This is a fairly normal type of curve with the stomach emptying in 3 hours. Pepsin digestion was 6 mm. and occult blood was slightly positive.

Microscopy of the final (3 hr.) specimen revealed:—

Starch granules many.	Mucous ribbons few.
Fat globules many.	Yeast cells few.
Bile salts many.	Pus few.

Gastroscopic Diagnosis:—Peptic ulcer—lesser curvature.

Operative Findings:—Peptic ulcer on the lesser curvature of the stomach perforated to the posterior abdominal wall. Subtotal gastrectomy was performed.

Pathological Report:—Gastric ulcer; 1 cm. in diameter; perforated; benign.

Nonsignificant Analysis:—Male:—Aged 42, with upper abdominal distress occurring while postoperative for acute pancreatitis.

X-ray:—Active ulcer on the greater curvature of the stomach.

Fractional Gastric Analysis:—

The fasting contents were normal in all respects and the patient took the tube well.

Total Acidity.	Q.N.S.	39	45	46	27
Free Hydrochloric Acid.	Q.N.S.	25	35	34	14

This is a normal type of curve with the stomach emptying in 2 hrs. Occult blood was negative.

Microscopy of the final (2 hr.) specimen revealed:—

Bile salts many.	Pus cells few per H.P.F.
Fat globules few per H.P.F.	Starch granules few per H.P.F.
Mucous strands few per H.P.F.	

Gastroscopic Diagnosis:—Gastric ulcer.

Discussion:—A more normal analysis in the nonsignificant case would be difficult to find, yet a serious pathology existed.

Gastric Carcinoma

Significant Analysis:—Female:—Aged 67, with epigastric burning, attacks of nausea and vomiting for 11 months prior to admission. Loss of 24 pounds in past 5 months. The patient appeared to make satisfactory progress under the physician's care, but was sent to the hospital for observation and survey.

Stools:—Were 3 plus positive for occult blood.

X-ray:—There was ptosis of the stomach with a filling defect on the greater curvature at the junction of the pars media and pylorica. Rapid gastric emptying.

Fractional Gastric Analysis:—

Last meal 15½ hrs. before.	Food rests plus.
Fasting contents 48 c.c.	Gastric epithelium plus.
Mucoid appearance with decayed material present.	R.B.C. plus.
	Pus plus.
Reddish brown color.	Took tube well.
Putrid odor.	
Blood both macroscopically and occult.	

Total Acidity.	10	25	15	16
Free Hydrochloric Acid.	0	0	0	0
Mucus.	+	+	+	+
Occult Blood.	++	Tr	Tr	Tr

This is an achylic type of curve as far as it goes, but the tube had to be removed at the end of 1½ hrs. as the patient began to bleed severely.

Microscopy of the final (1½ hr.) specimen revealed:—

Bile salts plus.	Pus plus.
Undigested food few.	R.B.C. 3 plus.
Duodenal epithelium few.	Mucus plus.

Gastroscopic Diagnosis:—Gastric carcinoma, Type IV; greater curvature near pylorus.

Operative Findings:—Carcinoma as described above. The pylorus was not obstructed, but hepatic metastases were present.

Pathological Report:—Adenocarcinoma of the stomach.

Nonsignificant Analysis:—Male:—Aged 59, with a typical ulcer syndrome treated successfully. There was a recurrence 2 years later with a repetition of the successful therapy. Eight weeks ago the condition began again, but this time a palpable mass was noted in the left upper quadrant. There was a loss of 24 pounds in the last seven weeks and the patient could tolerate only liquids. No stools were obtained without laxatives or enemata.

Stools:—Were positive—a trace, 2 plus, and one plus respectively on three determinations for occult blood.

X-ray:—There was a second degree ptosis; a large filling defect on the lesser curvature extending from the pylorus to the junction of the middle and upper thirds of the stomach. This was diagnosed as an extensive gastric neoplasm with no obstruction.

Fractional Gastric Analysis:—

Last meal 15½ hrs. before.	Duodenal epithelium few.
Fasting contents 50 c.c.	R.B.C. few.
Bile 3 plus.	Pus few.
Mucus mixed plus or minus.	Bile salts plus.
Occult blood plus.	Crystals plus.
Food rests few.	Calcium bilirubinate pigment plus.
Mucous strands plus or minus.	Boas-Oppler bacilli plus.
Gastric epithelium plus or minus.	Took tube well.

Total Acidity.	10	38	30	36	34	20	16	20
Free Hydrochloric Acid.	0	24	20	18	18	14	10	0

This is a normal type of curve with the stomach emptying in 3½ hrs.; occult blood 2 plus.

Microscopy of the final (3½ hr.) specimen revealed:—

Undigested food plus.	Bile salts plus.
Yeasts plus.	

Gastroscopic Diagnosis:—Gastric carcinoma; Type IV.

Operative Findings:—An extensive neoplasm infiltrating the lesser curvature from the antrum to the cardia. One nodule in the gastrocolic omentum. Almost total gastric resection performed.

Pathological Report:—Mucoid carcinoma of the stomach.

Discussion:—The significant case shows blood both grossly and microscopically, putrid odor, achylic curve, etc. The nonsignificant case shows very much less blood, an acidity over the accepted minimal 20 clinical units, and only a slightly prolonged emptying time—all in the presence of an advanced malignancy of an ultimately fatal outcome.

Pyloric Stenosis

Significant Analysis:—Female:—Aged 55, with a long history of indigestion, gas, and abdominal discomfort 2 hrs. after meals. There was also midline epigastric pain relieved by alkali. Nausea with retention type vomiting. Loss of 29 pounds in 3 months.

Stools:—Were negative for occult blood.

X-ray:—The greater curvature of the stomach was 4½ inches below the iliac crests. The walls of the organ were atonic and it was greatly dilated. There was no intrinsic gastric lesion, but 50 per cent of the barium meal was retained at the end of 5 hours. There was deformity of the duodenal cap with pyloric obstruction. There was marked retention at the end of 24 hours.

Fractional Gastric Analysis:—

Last meal 15 hrs. before.
Fasting contents 238 c.c.
Food residue very much.
Odor foul.
Blood macroscopic.
Blood occult 4 plus.
Food rests 4 plus.
Mucous strands 2 plus.
Fat globules plus.
Yeasts 2 plus.
Bacteria few.
Sarcinae plus.
Took tube well.

Total Acidity.	104	111	58	70	89	110	105	76
Free Hydrochloric Acid.	89	85	47	60	79	90	90	65

This curve is not typical of any type mentioned, but the greatly prolonged emptying time must be noted. At the end of 3½ hours the stomach was not empty, but due to the insistent demands of the patient that the tube be removed, 80 c.c. were withdrawn and the tube lifted. Occult blood, 4 plus, was present in each and every fraction throughout the analysis.

Microscopy of the final (3½ hr.) specimen revealed:—

Undigested food 4 plus.
Yeast cells 3 plus.
Mucous strands many.
Fat globules 2 plus.
Bacteria few.

Gastroscopic Diagnosis:—Pyloric obstruction, benign in type; duodenal ulcer. Superficial gastritis.

Nonsignificant Analysis:—*Male:*—Aged 50, abdominal pain and vomiting for 6 months. Loss of 20 pounds. Appeared cachectic and dehydrated.

Stools:—Showed occult blood, 4 plus, on 2 examinations; 3 plus on one examination, and negative 3 times.

X-ray:—Malignant lesion of the pylorus causing obstruction.

Fractional Gastric Analysis:—

Fasting contents 15 c.c.
Fat globules few.
W.B.C. too numerous to count.
Bacteria too numerous to count.
Mucus mixed trace.
Oral epithelium few.
Took tube well.

Total Acidity.	28	26	30	32	20	24
Free Hydrochloric Acid.	12	10	10	14	8	10
Bile.	—	—	—	—	—	Tr
Mucus.	Tr	Tr	—	—	—	Tr

This is a fairly normal type of curve with the stomach emptying in 2½ hrs. Occult blood was negative.

Microscopy of the final (2½ hr.) specimen revealed:—

Starch granules few.
Bile salts few.
Fat globules few.
Bacteria, non-motile, many.

Gastroscopic Diagnosis:—Pyloric obstruction, malignant; chronic superficial gastritis; hemorrhagic erosion.

Discussion:—The significant case is a typical one of benign pyloric obstruction. Although the cause of the obstruction in the nonsignificant case is not the same as that in the significant case, nevertheless, obstruction would not be apparent in the nonsignificant case from the gastric analysis alone since there is a normal amount of fasting contents, normal emptying time, very little evidence of food retention, and some slight regurgitation of duodenal contents.

Duodenal Ulcer

Significant Analysis:—Female:—Aged 53, with pain on the left side of the abdomen at the level of the 10th rib; the pain radiates to the substernal and epigastric areas. It began 3 weeks prior to admission after a bout of black stools followed 3 days later by an attack of coffee ground vomitus.

Stools:—Were negative for occult blood.

X-ray:—Stomach normal. Duodenal ulcer present with a small calculus in the gallbladder.

Fractional Gastric Analysis:—

Last meal 12 hrs. before.		W.B.C. few.			
Fasting contents 5 c.c.		Pus cells few.			
Mucous strands few.		Took tube badly.			
Gastric epithelium occasional.					
Total Acidity.	26	26	41	65	65
Free Hydrochloric Acid.	16	16	28	48	50

This is a typical extragastric type of curve with the stomach emptying in 2 hrs. Occult blood was negative.

Microscopy of the final (2 hr.) specimen revealed:—

Starch granules few.	Bile salts few.
Fat globules few.	Yeast cells few.

Gastroscopic Diagnosis:—Superficial gastritis, a few patches in an otherwise normal stomach; duodenal ulcer.

Nonsignificant Analysis:—Male:—Aged 83, with upper abdominal pain coming on 10 minutes after meals and radiating to the right and to the umbilicus. Marked tenderness at umbilical region. Poor appetite; weakness; loss of 17 pounds in 7 weeks; severe constipation; large mass in the upper abdomen.

Stools:—Were negative for occult blood 7 times in succession.

X-ray:—Duodenal ulcer; large extragastric mass.

Fractional Gastric Analysis:—

Fasting contents 6 c.c.		Food rests plus.			
Bile plus.		Bile salts plus.			
Mucus mixed plus.		Took tube well.			
Total Acidity.	30	15	25	20	15
Free Hydrochloric Acid.	0	0	0	0	0
Bile.	+	—	—	±	±
Mucus.	+	+	—	—	—

This is an achylic type of curve with the stomach emptying in 2 hours. Occult blood was negative.

Microscopy of the final (2 hr.) specimen revealed:—

Mucus plus or minus. Pus plus or minus.
Food rests plus or minus. Yeasts plus or minus.
Bile salts plus or minus.

Gastroscopic Diagnosis:—Gastric hyperemia attributed to external compression; distortion of the stomach due to extragastric mass; superficial gastritis; duodenal ulcer.

Peritoneoscopy:—A mass in the right upper quadrant of the abdomen either peritoneal or retroperitoneal. The right lobe of the liver is involved in adhesions and the left lobe is deformed. The pars media of the stomach was visualized and appeared to be normal.

Discussion:—While the significant case does not show excessive acidity, nevertheless, it shows a typical extragastric type of curve with prompt emptying. The few patches of superficial gastritis noted would hardly be compatible with the extragastric type of curve.

On the other hand, the nonsignificant analysis which shows an achylic curve is a totally unexpected finding in the presence of duodenal ulcer, which enjoys a reputation for causing hyperacidity. The lack of acidity is not due to regurgitated bile since it was present in 2 specimens where there was no biliary regurgitation, and in two where it was so small as to be rated plus or minus. Certainly this analysis alone would have made one suspicious of many things, but not of duodenal ulcer. The presence of the extragastric tumor is not to be considered too seriously since it did not spring from the stomach per se, or involve it in any way except by pressure.

As an interesting sidelight to this paper we may raise the question, "Does peptic ulcer cause hyperacidity?"

Of the 13 cases of gastric ulcer in this series 3 showed a Grade I hyperacidity, while 10 showed a normal or subnormal acidity: 23.1 per cent as compared to 76.9 per cent.

Of the 21 cases of duodenal ulcer in this series 2 showed a Grade I, 2 showed a Grade II, and 2 showed a Grade III hyperacidity, while 15 showed a normal or subnormal acidity: 28.56 per cent as compared to 81.44 per cent.

In this particular series hyperacidity was neither a frequent, prominent, nor reliable sign of peptic ulceration of the stomach or duodenum.

While there were many instances of multiple diagnoses among the cases, there are 6 cases of double lesions which are especially interesting and thought provoking. Although not sufficient in number to be statistically significant, nevertheless, they should be carefully evaluated and kept in mind for checking with similar findings by other investigators.

Case R. 41:—Showed two distinct lesions in the stomach; the peptic ulcer, of typical appearance and location—prepyloric, lesser curvature; and the carcinoma at

the pylorus. The complete diagnosis was carcinoma of the pylorus, Type IV; pyloric obstruction, partial; peptic ulcer; superficial gastritis, diffuse.

Case R. 61:—Showed two distinct lesions in the stomach; the peptic ulcer and the carcinoma. The complete diagnosis was carcinoma of the posterior wall of the stomach adjacent to the pylorus, but not obstructing it; peptic ulcer; hypertrophic gastritis, diffuse. This diagnosis was proven and sustained at operation.

Case R. 42:—Showed a typical duodenal ulcer and a new growth involving the pyloric end of the stomach. The complete diagnosis was carcinoma of the pylorus, Type III; pyloric obstruction, partial; atrophic gastritis, mild, diffuse; duodenal ulcer. This diagnosis was proven and sustained at operation.

Case R. 78:—Showed a pathology commensurate with a complete diagnosis of peptic ulcer of the stomach; varicosity of the gastric blood vessels; atrophic gastritis, mild.

Case R. 44:—Gave a complete diagnosis of peptic ulcer of the duodenum; cardiospasm; gastrospasm; atrophic gastritis, pars media and cardia; hypertrophic gastritis, pars media and cardia. The free hydrochloric acid was *zero!*

Case R. 69:—Gave a complete diagnosis of peptic ulcer of the duodenum; atrophic gastritis; colitis simplex. The free hydrochloric acid was *zero!*

Realizing that such a small number of cases is not significant, nevertheless, we do have evidence that gastric ulcer and carcinoma can occur simultaneously in the same stomach as distinct and separate lesions, and that the old dictum of "Where there is no acid there is no ulcer" cannot be sustained in the light of these two latter cases. These facts deserve thought and attention, and should be considered with similar cases reported by other investigators as time goes on.

Finally in the light of all the foregoing we must ask and attempt to answer the question: "Is gastric analysis useful enough diagnostically as to be worthwhile?" and our original question: "If a doctor did not have available x-ray or gastroscopic studies, would he be justified in diagnosing and treating a given case solely upon the findings of a properly performed fractional gastric analysis?"

A study of the data reveals that in the 100 cases reviewed 52 showed a significant analysis and 48 showed a nonsignificant analysis. This makes the situation practically equal for the two arbitrary subdivisions of gastric analysis used in this paper. When we add to this the fact that the 52 significant analyses show only possible gastric pathology, but give no indication of what that pathology is, nor the degree of its severity, we must conclude that gastric analysis is not of general use nor of any special significance in routine admissions.

Hence we submit the following reasons for and against gastric analysis, most of which are reiterations of those mentioned in the introductory remarks.

In Favor of Gastric Analysis:—1. A differential diagnostic aid in pernicious anemia or in a macrocytic idiopathic anemia.

2. While the presence of abnormalities of acidity may be due to functional and temporary causes, they may also be suggestive of organic diseases.

3. For the study of acidity after gastric resection to estimate the likelihood of recurrence.

4. As a contribution to the sum total of the knowledge of gastric physiology, pathology, and pathological physiology.

5. Gastric intubation must be continued to obtain material for cytodiagnosis, recovery of tubercle bacilli, etc.

6. As to the remark that gastric analysis be done as a diversion, we can say only that there are many things far more diverting for doctor and patient alike than the performance of a gastric analysis.

Against Gastric Analysis:—1. Even though abnormal findings are present in the gastric analysis, they are rarely pathognomonic or even diagnostically suggestive of any given gastric pathology.

2. Gastric analysis will not necessarily demonstrate organic gastric disease.

3. Variations in the constituents of the gastric juice from day to day are so great that any one analysis becomes unreliable. Therefore, the findings of gastric analysis cannot be trusted from a statistical standpoint.

4. In most cases neither the prognosis nor the treatment will be influenced by the results of the gastric analysis.

We conclude from all the above that unless specifically desired for some definite reason, gastric analysis is useless in the average case, and little or nothing of serious consequence to the patient will be lost if its performance be omitted, providing the stomach is studied gastroscopically and roentgenologically.

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THE GASTRIC ULCER PROBLEM

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The gastric ulcer problem is especially important at this time because we are all trying to improve our results in the cure of one of the common causes of death, namely carcinoma of the stomach. It is estimated that 40,000 people die in the United States yearly from this one condition. The polypoid, protruding, infiltrating carcinoma is usually self-evident, relatively easy to diagnose, and presents no question as to the proper therapy. About 20 per cent of cases of carcinoma of the stomach originate as an ulcer, and it is in this group that we hope to salvage more cases by early diagnosis and appropriate treatment. Allen[1] at the Massachusetts General Hospital reports that only 50 per cent of cases coming to this institution are resectable with 5 year survivals only 7 per cent. Sweet[2] summarized statistics from various sources and found that in proven carcinoma cases not over 5 per cent survive 5 years, and that at most 50 per cent are resectable. The explanation of these poor results lies in the insidious onset of symptoms, neglect of early symptoms by the patient, and, in too many cases, failure of the attending physician to thoroughly establish the correct diagnosis.

It is important that an early diagnosis of the exact nature of the condition be made by a thorough history, physical examination, radiologic study, and gastroscopy when indicated. This *must* precede treatment since a bland diet, antacids and sedatives relieve not only peptic ulcer but also peptic esophagitis, simple hyperacidity, and "irritable colon". It is important to remember that gastric and duodenal ulcers may be associated in the same patient. Rivers[3] in a study of a group of duodenal ulcers at the Mayo Clinic found that 6 per cent of this series had an associated gastric ulcer, and of a group of gastric ulcer cases, 5.2 per cent had a coexistent duodenal ulcer. In 4 per cent of gastric ulcer cases multiple ulcers were present.

The clinical differentiation of gastric and duodenal ulcer is not easy. It is generally accepted that some gastric acidity must be present to cause peptic ulcer whether gastric or duodenal. The pain in both types may be similar in character and in time relation to food intake. The actual cause of the pain is the same in both types of ulcer and depends upon which theory we accept. The cause of the pain has been ascribed to increased tension of the gastric wall by Hurst, to peristaltic tension similar to hunger contractions by Carlson, and to the action of acid on the ulcer bed by Sippy. It is well to remember the important work of Bowney and Pickering, in amplifying Palmer's pioneer findings, that the pain of ulcer may be caused to reappear by the reinjection of acid chyme into the stomach of a patient with peptic ulcer, whereas the introduction of gastric contents in which the free acid has been neutralized did not produce the pain. Bloomfield[4] describes two types of pain in ulcer, namely 1, the steady pain associated with penetration of the ulcer through the mucosa and muscularis layers to cause peritoneal irritation and associated with tenderness to pressure, and 2, the more common ulcer pain of fullness, burning,

regurgitation of sour material, occurring at regular intervals and relieved by food and alkali.

While the classical rhythm of gastric ulcer pain, i.e. "food, comfort, pain, comfort" is much less constant than that of duodenal ulcer with its "food, comfort, pain" it mimics the latter so often that it is difficult to differentiate the two lesions by clinical symptoms alone. In some patients with gastric ulcer a large meal may aggravate the distress and make the pain appear earlier. Similarly, seasonal occurrences are not as prominent in gastric ulcer. Bouts of nausea and vomiting are more frequent in gastric ulcer than in uncomplicated duodenal ulcer, and are usually ascribed to an associated pylorospasm. The repeated occurrence of vomiting soon after meals in patients with gastric ulcer suggests the hour-glass type of stomach.

While the gastric analysis does vary in typical cases of duodenal and gastric ulcer there is no classical pattern in all cases. The average acid levels in cases of gastric ulcer show a figure averaging 5 units below normal patients, whereas in duodenal ulcer the average is 10 units above normal. Marginal ulcers have even higher figures for gastric acidity. But cases of gastric ulcer occasionally have high acid curves and therefore a gastric analysis is but one link in the chain of evidence for a given diagnosis to be confirmed by other methods. The volume of gastric juice and its acid titre is greatest in ulcer involving the pyloric canal and approaches normal as the site of the ulcer nears the cardia.

A complete gastrointestinal study with the aid of barium, including careful mucosal studies, is still our most available and most accurate means of diagnosis. Gastroscopy is helpful in doubtful cases, and should be used to confirm the presence of the ulcer in doubtful cases and as we shall see later to attempt to differentiate a benign from a malignant ulceration. As Ricketts and Pollard[5] point out, it is generally agreed that the shape, contour, motor function, and gross lesions are better seen by radiologic study, while mucosal changes and small lesions are better seen gastroscopically. They studied 1,297 patients by both methods and conclude that both methods are best used together.

Since gastric ulcer must be treated with more certainty than any other gastric lesion, the exact location of the ulcer must be established before treatment is begun. This will help to determine whether a given ulcer is benign or malignant in appearance and whether surgery or medical treatment is indicated. There are two definite indications for immediate surgery in gastric ulcer. Firstly, it is generally agreed that any ulcer on the greater curvature of the stomach should be considered malignant, and so treated. Sproull[6] in a careful review of the literature found only 10 proven cases of benign ulcer of the greater curvature. Only 2 proven benign ulcers of the greater curvature have been seen at the Lahey Clinic. Secondly, the occurrence of achlorhydria in the presence of gastric ulcer points to malignancy and surgery is the treatment of choice. About 60 per cent of patients with proved carcinoma of the stomach have achlorhydria. However, it must be remembered that some cases of carcinomatous ulcer have a hyperacidity, and one should not be

misled by such a finding. I might add here that some gastroenterologists include prepyloric ulcer in the potentially malignant group but this is still debatable.

In all other cases diagnosed as gastric ulcer we should attempt, before proceeding with treatment, to rationalize on the basis of experience as to whether a given ulcer is either benign or malignant. It is generally agreed that an ulcer is either benign or malignant from its inception and does not change its morphology with time. Frances Smith and Sara Jordan[7] do believe that recurrence does increase the chance of malignancy. The following points of differentiation should be considered:

1. *Clinically:*—Carcinoma cases tend to have more persistent pain with frequent night attacks.

2. *Size:*—Larger ulcers tend to be malignant, especially if over 2.5 cm.

3. *Location:*—As stated above nearly all greater curvature ulcers are malignant. Rivers[8] finds that about 65 per cent of ulcers within 2.0 cm. of the pyloric valve are malignant.

4. *Age:*—The age of the patient and the duration of symptoms. Ulcers tend to be benign in patients under 45. In patients over 45 with a recent ulcer history malignancy is more likely.

5. *Gastric analysis:*—This has been discussed.

6. *The Papanicolaou stain:*—We have advocated this as an aid in the differentiation of the benign from the malignant ulcer.

Pollard, Bryant, Block and Hall[6] in a study of 278 cases found positive smears in only 35 per cent of proven carcinoma cases and indefinite or negative in 65 per cent. They concluded that it is not to be used for positive diagnosis, and is to be used only when experienced and specially trained pathologists are available. In a small series done by me, the results were unsatisfactory as compared to the more positive data obtained by roentgen study and gastroscopy.

7. *Gastroscopy:*—Moersch[9] in 100 selected cases of proven carcinoma found gastroscopy correct in 70 cases, and roentgen examination correct in 52 per cent. Benedict[10] finds that if a gastroscopist can get a satisfactory view of the lesion his chance of arriving at a correct conclusion are greater than with x-ray examination. Barowsky[11] has summarized the gastroscopic differences between the benign and malignant ulcer as follows:

Benign	Malignant
1. Situated on a flat surface.	1. Usually on an elevated area.
2. Deep, punched out and crater-like.	2. Bowl shaped and shallow.
3. Margin is well defined in its entire circumference.	3. Margin is round, sloping and generally does not form a complete circumference. It may be lost in the adjacent tissue.
4. Color is gray and whitish.	4. Usually many colored, necrotic, and dark brown dirty color.
5. Floor: generally even, flat, and smooth.	5. Floor: irregular, nodular, has ridges, and pieces of necrotic tissue may be seen.
6. Surrounding area: normal or inflamed but always flexible.	6. Surrounding area: nodular, stiff, and appears infiltrated.

However, when one considers all the exceptions to the characteristic picture of the benign or the malignant ulcer one is forced to conclude that only the pathologist, after careful histologic study, can give us a conclusive diagnosis.

It is because of this difficulty in differentiation that many surgeons and some gastroenterologists have come to the conclusion that once the diagnosis of gastric ulcer is made surgery is the only treatment. However, careful statistical analysis from some of our leading clinics show that the picture is not so hopeless that we must subject all our patients to the radical treatment of subtotal gastrectomy. Smith and Jordan[7] in an analysis of 600 cases of gastric ulcer found an incidence of only 9.8 per cent of carcinoma in the entire series. Marshall and Welch[12] found an incidence of only 26 cases or 3.3 per cent in 800 cases of gastric ulcer treated medically and surgically. Only 131 of their 800 cases required surgery and in these severe cases that were deemed surgical only 26 or 19.8 per cent were found to be malignant. Allen and Welch[13], in 277 cases treated medically and surgically, found 39 or 14 per cent to be malignant. Judd and Priestley[14] state that in their experience the error in the preoperative diagnosis of the benign from the malignant ulcer is approximately 10 per cent. Therefore, it is certainly not good sound medicine to subject the 90 per cent of benign gastric ulcers to the only operative procedure considered adequate in these cases, namely subtotal gastrectomy, when, by following a well established routine, we can arrive at the correct diagnosis in approximately 90 per cent of cases. This percentage is probably better than our averages in most clinical problems.

The proper approach to these cases where the greater curvature is not involved, and gastric acidity is present, is to place the patient under strict medical care for a period of about four weeks, preferably at bed rest. Small frequent feedings of a bland diet with appropriate antacids, antispasmodics, and sedatives are prescribed. This treatment should be carried out for about four weeks, and then the status of the ulcer should be checked with a roentgen study. Mere quiescence of symptoms does not indicate a healed lesion. Cummins, Grossman and Ivy[15] have demonstrated that the average healing time for 63 duodenal ulcers is 40 days with a range of 13 to 68 days. Smith and Jordan[7] in 145 cases of gastric ulcer found roentgen evidence of healing complete in 4 weeks in 84 of 145 cases and by 8 weeks, 136 of the 145 were healed. Gastroscopically, 3 cases showed healing in 21 to 52 days with an average of 37 days. These authors conclude that there is no correlation between healing time and the size of the ulcer or age or recurrence or duration of symptoms. At the end of four weeks the ulcer defect should be entirely healed by roentgen examination with no dimpling of the gastric wall and no rigidity of the musculature present. The patient should be free from symptoms and the stool should be negative for occult blood. As a final opinion gastroscopy is most helpful. If the ulcer has not healed by the above criteria then surgery is indicated. Recurrence of the ulcer or hemorrhage or obstruction are considered indications for surgical intervention. Smith and Jordan[7] in their study of 600 cases advised surgery in 7 per cent of the series because of a clinical diagnosis of carcinoma, 35 per cent because of a diagnosis of probable carcinoma, 33 per cent because of recurrence, 13.7 per cent because of obstruction, 9.9 per cent because of failure to heal or hemorrhage.

By this four week clinical therapeutic test we should be able to separate the simple uncomplicated benign cases which will be cured by medical therapy alone. The indications for surgery will include all doubtful cases. Carcinomatous ulcers may show temporary healing but this is never complete and the patient will show recurrence by symptoms and roentgen examination especially if the recheck is done at monthly intervals for about a year. It is the opinion of gastroenterologists that no physician should treat a patient with gastric ulcer unless he is prepared to follow the patient most carefully. Then the most good will be done for the greatest number of patients, namely those with benign ulcer. These patients will be returned to normal with no radical amputation of a large part of their stomach.

The surgery of choice for gastric ulcer is subtotal gastrectomy. Adequate subtotal gastrectomy cures these patients in almost 100 per cent of cases. Vagotomy has no place in the treatment of gastric ulcer since it is essential to excise the ulcer for histologic study. Irradiation of the stomach has been used by Palmer and his associates[16,17] to produce an achlorhydria. He found 45 of 50 cases healed in a month as compared to 60 per cent medical cures. However ⅓ recurred within 2 years. Irradiation may be considered in conjunction with medical care since he reports no symptoms from the irradiation.

While the gastric ulcer is cured by surgery not all cases are symptom-free after surgery. As long as surgeons maintain that the open ulcer is the only cause of symptoms and forget the underlying psychological problems and stresses, so long will patients continue to complain of various gastrointestinal symptoms after surgery is done and the patients return to their old poor eating habits, smoking, alcohol, etc. Healing of the ulcer does not guarantee freedom from the vices of motility changes that produce indigestion. Ivy[18] reports an incidence of incomplete relief from symptoms in 12 per cent of 147 cases; Sara Jordan[7] reported only 57 per cent completely free from symptoms. Adlersberg and Hammerschlag[19] report 6 to 38 per cent of patients have gastric symptoms after subtotal gastrectomy regardless of the type of gastrectomy done. They describe two types of postoperative symptom-complexes: First, the "early type" with epigastric pressure, nausea, fullness, gaseous eructation, belching, dizziness, and occasional vomiting. This type comes on soon after eating and is usually due to mechanical factors as filling or distention of the afferent loop, or rapid emptying or rapid filling and distention of the jejunum with subsequent mesenteric irritation or even a gastritis. This type is usually helped by small frequent feedings. The "late type" comes on 2 to 3 hours after meals and consists of headache, fatigue, weakness, perspiration, palpitation, dizziness, dyspnea, and occasionally precordial pressure. These symptoms are usually ascribed to chemical factors, i.e., a rapid, steep decrease in the blood sugar level resembling a typical hypoglycemic reaction. Food intake, especially a high protein diet with large doses of vitamins and liver, helps many of these cases. Rest in bed may help both types.

In other words, while subtotal gastrectomy in gastric ulcer almost invariably produces an achlorhydria and cures the ulcer lesion, these patients should be fol-

lowed with medical supervision. Our efforts should be directed not only to cure the ulcer but to render our patients entirely symptom-free and in addition to salvage a much larger number of early carcinomatous ulcers.

Illustrative Case Problems

Case 1:—Miss A. S., age 34, single, came to me on October 5, 1948, with a chief complaint of epigastric burning pain. This symptom had been present off and on for the past 3 years. The pain came on 2 to 3 hours after meals and was relieved by food or vomiting. She rarely had night pain. Physical examination was negative. There was no significant weight loss. A stool specimen was strongly positive for occult blood. Wassermann was negative, and a gastric analysis showed 20 units of free hydrochloric acid after an Ewald meal and a total acidity of 30 units. A gastrointes-

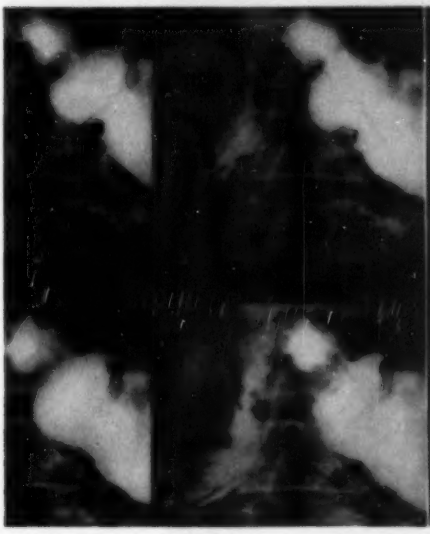

Fig. 1

Fig. 2

tinal roentgen study at this time showed a shallow ulcer on the posterior wall of the lesser curvature with compression studies (see Figs. 1 and 2). Gastroscopy was done and the presence of the ulcer was confirmed. The surrounding tissue appeared normal and peristalsis passed through this area. The margins of the ulcer were fairly sharp. A therapeutic test with a strict medical regime was instituted with the patient hospitalized. After two weeks of intensive treatment the symptoms were unimproved. Gastroscopy and roentgen study were repeated and showed little change in the appearance of the ulcer. Surgery was advised, and on November 20, 1948 a subtotal gastrectomy was done by Dr. Harold Hantman. The pathological report was a shallow ulcer 4 mm. by 12 mm. in diameter with cells of adenocarcinoma deep in the submucosa and inner circular muscular coat. The pathological diagnosis was ulcerating adenocarcinoma. To this date the patient is much im-

proved although some burning distress is still occasionally present after meals. She is gaining weight slowly.

Comment:—The age of the patient and the three year history spoke for a benign ulcer. Furthermore, when I examined roentgen films taken on September 26, 1947 by a radiologist, I was able to see a similar ulcer defect although the examination was reported as negative on that date. However, the symptoms and gastroscopic and roentgen findings were unchanged after two weeks of strict medical care and therefore surgery was advised.

Fig. 3

Case 2:—Mr. O. B., age 50, married, letter carrier, came to me on February 10, 1947 because of dizziness, weakness, and a history of tarry stools for the past two days. He denied any gastrointestinal symptoms prior to February 8th. He appeared pale and showed a hemoglobin of 9.5 grams, a red count of 2,900,000 cells per cu. mm., white count 10,500 with a normal differential count. Pulse was 120 and his blood pressure 100/70. Rectal examination confirmed the presence of a tarry stool. He was hospitalized and the Andresen bleeding ulcer regime instituted. He never had gastrointestinal distress and he was soon placed on a bland Sippy diet. A radiologic study after two weeks showed no evidence of ulcer or neoplasm in the gastrointestinal tract. Gastroscopy was then done, and a healing shallow gastric ulcer was seen about one inch above the angularis. A review of the films after

the gastroscopy showed a suspicious area on the lesser curvature which seemed to correspond with the lesion seen under the gastroscope (see Fig. 3). A gastric analysis at this time showed a maximum free hydrochloric acid of 23 units and a total of 35 units. By March 31, 1947 his hemoglobin had reached 15.0 grams after iron and liver therapy and one blood transfusion. He has felt perfectly well for the past two years with no recurrence of the bleeding to date. Radiologic checkup on January 7, 1949 showed no evidence of the ulcer.

Comment:—The recent history and the age of the patient and the bleeding would appear to indicate the need of surgery. However, a three year follow-up has confirmed the benign nature of the ulcer. We have every reason to believe that this patient should continue well.

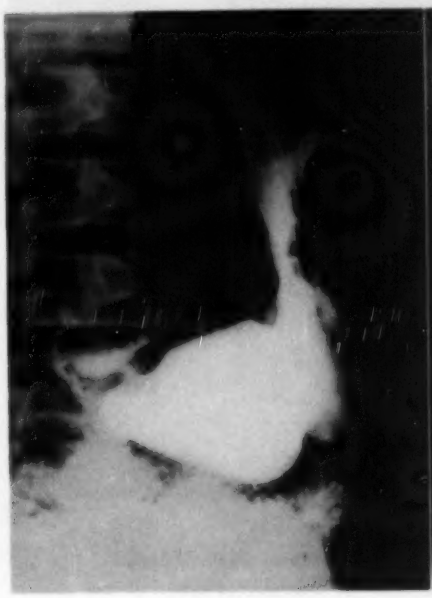

Fig. 4

Fig. 5

Case 3:—Mr. A. S., age 49, married, a clerk, was referred to me by Dr. Harry Schreck on May 25, 1948 with a history of repeated gastric hemorrhages. In 1942 his case was diagnosed at the Orange Memorial Hospital as a bleeding gastric ulcer. He required five blood transfusions at that time. In 1944 and 1946 he had recurrences of gastric distress without bleeding. The last episode began in December 1947. The pain occurred 2 hours after meals and was relieved by milk. A gastric analysis at this time showed a free acidity of 10 units after histamine and a total acidity of 20 units. A gastrointestinal study at this date showed a large gastric ulcer midway between the cardia and the incisura angularis. The ulcer was about 1.0 cm. in depth and 2.5 cm. in width (see Fig. 4). The patient was treated by his family

physician for four months. His symptoms improved for a time and then recurred. He was sent back to me for a re-examination and the ulcer defect seemed healed (Fig. 5). Gastroscopy was refused by the patient. He finally consented to surgery after another relapse and a subtotal gastrectomy was done on January 19, 1949. The pathological report was a benign gastric ulcer with scattered small hemorrhagic erosions in the rest of the fundus.

Comment:—Recurrence in this case was the prime indication for surgery. It is interesting to note that the ulcer pain was 2 hours after meals just as in the first case. This same time relation to food intake is usually found in duodenal ulcer and that is why it is difficult to make a diagnosis without radiologic analysis.

Fig. 6

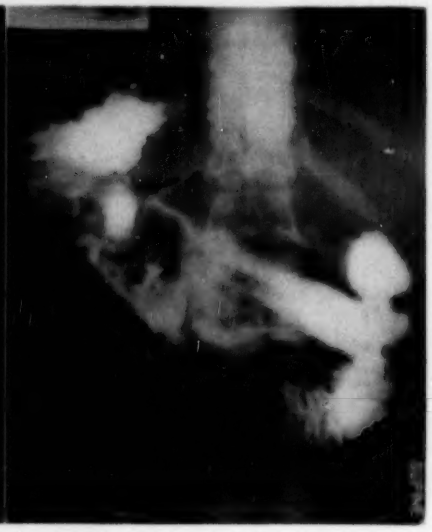

Fig. 7

Case 4:—Mrs. L. B., age 56, married, housekeeper, was referred to me on October 15, 1948 by Dr. A. B. Abrams because of spasmodic pains in the upper abdomen. In 1942 she had had a cholecystectomy for cholelithiasis. This operation did not relieve her gastric symptoms and she was treated for a postcholecystectomy syndrome. She had episodes of pain just below the xiphoid process, crampy in character, occurring one-half to one hour after meals, lasting minutes to two hours, and usually relieved spontaneously. She did not get relief from food or alkali. She had lost ten pounds in the past year. A stool specimen was positive for occult blood. Gastric analysis showed 20 units of free hydrochloric acid after an Ewald meal and 30 units of total acidity. A gastrointestinal study showed a large gastric ulcer high on the lesser curvature (Fig. 6). She was put to bed and placed on a strict Sippy regime. After four weeks the symptoms had cleared entirely and the patient felt better than she had for years. Her stools became negative for occult blood. Re-

examination with a barium meal roentgen study showed a shallow ulcer still present (Fig. 7). Gastroscopy was advised. At gastroscopy at the site of the roentgen defect a large area of ulcerated, sloughing tissue about 2.5 cm. in diameter was seen. The appearance was interpreted by me as malignant and surgery was advised. A subtotal gastrectomy was done and revealed a perforating gastric ulcer deeply imbedded into the liver bed. The pathological report showed no evidence of malignancy. The patient made a good recovery and is very well to date.

Comment:—This was a large ulcer on the lesser curvature and responded completely to medical care insofar as the clinical symptoms were concerned. It was difficult to convince the patient that rechecking was necessary. But the roentgen study and the gastroscopy showed incomplete healing and therefore surgery was indicated and done.

Fig. 8

Fig. 9

Case 5:—Mrs. B. K., age 42, housewife, was referred to me by Dr. A. B. Abrams on April 8, 1948 with a chief complaint of recurrent epigastric pain. She had had a cholecystectomy in 1928. Her gastrointestinal history dated back to May 1944 when she experienced burning distress in the epigastrium recurring about every three weeks, relieved by antacids although not related to food intake. In March 1945 the burning distress became more severe and a gnawing character was added especially at 2 to 4 a.m. In June 1945 a radiologic study was alleged to have shown a healed peptic ulcer. She was placed on a Sippy diet at that time but the symptoms recurred. In May 1946 a complete intensive gastrointestinal survey was reported as negative for ulcer but showed a large diverticulum of the second portion of the duodenum. Surgery was considered for this lesion but the patient declined.

A bland ulcer diet was advised and the patient gradually felt better. In December 1946 the pain recurred and a recheck at that time was reported as showing a suspicious duodenal ulcer.

She came to me on April 8, 1948 with a history of another recurrence of similar pains. This last attack began four weeks previously following a vomiting spell due to a dietary indiscretion. She described the pain as of the hunger type, radiating through to the back, not related to food intake, and lasting a half hour up to a full day. Food did not always relieve the pain. Baking soda gave the most relief. There was no weight loss. Physical examination was entirely negative. Laboratory data was all negative and she refused a gastric analysis. In May 1946 a gastric analysis showed a free hydrochloric acid of 30 units and a total acidity of 45 units. A gastrointestinal study was done with a barium meal and a small gastric ulcer was demonstrated with compression studies. It was situated on the posterior wall of the lesser curvature at the entrance to the pyloric antrum (Figs. 8 and 9). There was a constant hourglass type of incisura in all the films. Gastroscopy was refused and a strict Sippy regime was instituted. There was fairly good clinical improvement and on May 6, 1948 a fluoroscopic recheck was done. The ulcer niche was not seen but the hourglass deformity was still present. She was not seen again by me until September 10, 1948 when her pain recurred. Fluoroscopy at this time still showed the hourglass deformity. Gastroscopy was insisted on but the patient preferred surgery. On December 9, 1948 a subtotal gastrectomy was done by Dr. A. B. Abrams. The pathological report was a "lymphosarcoma with areas of superficial necrosis containing numerous plasma cells". The mucosa was described as hemorrhagic, cobblestoned, and coarsely granular over an area extending 7.0 cm. from the pylorus. It was covered with a hemorrhagic material. The rugae were prominent.

Careful examination of the patient including bone marrow studies failed to show any evidence of lymph gland or other organ involvement. Radiation therapy was given to the stomach area postoperatively. The patient is gradually improving at the present writing.

Comment:—This patient gave a long, vague history over five years. Ulcer was suspected by many observers but no accurate localization was obtained until the last examination in April 1948. We must assume that the same lesion was present all this time since it is known that lymphosarcoma of the stomach is very slow in metastasis and even lymphatic permeation. In this case the advocates of immediate surgery in gastric ulcer would say surgery should have been done long ago but the only previous diagnosis was either duodenal ulcer or diverticulum of the second portion of the duodenum. Furthermore, even when the operation was done there was little external evidence of pathology and it was only when the specimen was opened that a lesion was seen. Even then it remained for the microscopic study to give us the basic diagnosis.

Conclusions

1. Early accurate diagnosis is essential before treatment is begun in the diseases of the stomach.

2. Gastric ulcers involving the greater curvatures and those associated with achlorhydria should be treated surgically only.

3. Other cases of gastric ulcer may be given a four week clinical trial under the strictest medical regime preferably with bed rest. Unless completely cured by clinical and radiological and gastroscopic standards surgery is advised. Recurrence, bleeding usually, obstruction—these are indications for surgery.

4. Adequate subtotal gastrectomy is the treatment of choice. Careful post-operative observation is advised to prevent recurrent gastrointestinal symptoms.

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DOUBLE GALLBLADDER

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A case of double gallbladder is presented, not from the standpoint of adding any new material or idea on the subject, but purely from the statistical angle, so that as many cases as possible be recorded in the literature and, from such number, the frequency of occurrence and the various types of this entity may more accurately be enumerated. Such statistics will furnish information as to its real rarity.

Many names are found in the literature of men who have recorded cases; of others who have reviewed the literature; and of one or two who have done this and then made a classification or group arrangement of cases according to anatomical aspects of the gallbladder or of arrangement and form of the cystic duct and its emptying into the common duct.

From the historical angle, credit must be given Cruveilhier for the best description of a double gallbladder. He called it "vesica divisa". In 1860 he had described a case in which there was an open connection between two gallbladders. Cruveilhier should be a name of significance to every gastroenterologist. When one searches the old historical material in this field, there is hardly a portion of the gastrointestinal tract in which he did not describe the pathology occurring there.

An estimate has been arrived at by some that the relative incidence of double gallbladder is about one case in five thousand cases. Personal experience would be biased that it occurred much more infrequently, as this is the first case seen in over twenty-five years of active gastrointestinal practice.

There seems to be a rather general concurrence of opinion as regards the classification of these cases made by Guyton only a few years ago and published in the American Journal of Surgery.

To save somebody time and possible inconvenience in searching for that article, the classification is herewith given. Prior to this classification, that of Boyden, published in 1926, was generally accepted, and Guyton's classification differs little from the first.

The case presented here did not seek medical advice or attention because of any symptomatology or distress. It was found in the course of a detailed physical examination, in which it had been stipulated that nothing was to be left unexplored or unexamined.

There has been a difference of opinion between the referring physician and ourselves as to whether surgery is indicated. We prefer to think of this gallbladder or these gallbladders as free from stone—functioning normally as manifested by the taking up and excreting of the dye, demonstrating no adhesions, kinks or bands hindering passage of bile to the common duct as demonstrated by the roentgenogram, therefore, providing no indication for surgical exploration or excision.

Boyden's Classification:—

A. Vesica divisa, or cleft gallbladder. The result of embryonic division of the primary cystic diverticulum forming a partial reduplication of the organ with two cavities emptying into a common cystic duct. On section, a longitudinal septum is found dividing the gallbladder into two sections.

Six such cases had been reported in the literature up to 1946.

B. Vesica Duplex. Cases where there are two gallbladders and two cystic ducts. The accessary gallbladder arises from either the cystic, hepatic or common bile duct.

Fig. 1—Double gallbladder illustrating both cystic ducts merging into one before entering the common bile duct.

This group can be further subdivided into the "Y" shaped type and the ductular type. In the former, the two gallbladders are usually bound together and occupy the same fossa of the liver. The two cystic ducts unite to form a common cystic duct which then empties into the common bile duct. In the ductular type the two cystic ducts empty separately into the common bile duct and the two gallbladders may be attached to separate lobes of the liver.

In the above classifications, Guyton had found eight cases of the vesica duplex of the "Y" type reported, and sixteen of the latter or ductular type, up to 1946.

Boyden made more use of the terms cleft gallbladder and diverticulous gallbladder. He also mentioned that a great and illustrious gastroenterologist of the Seventeenth Century, namely DeGraaf, who in doing his great researches on the pancreas, found that the domestic cat frequently had an extra gallbladder, but that it arose from the pancreas and that this peculiarity occurred only in the cat family.

Boyden also uses the terms tri-lobed—trabecular type—pseudo-duplex—pseudo-multiplex. At any rate the salient features in a case of double gallbladder are:

Only thirty-eight cases have been reported in the literature to date, 1949.

They may be of two types: bifid, or bilobar.

One gallbladder divided into two parts. This may be by either a longitudinal septum or a transverse septum. The latter is in reality a misnomer, as it does not represent essentially two gallbladders.

The real true double gallbladder type is that in which there is an accessory gallbladder, meaning that there are actually two separate organs. Usually there will be two separate cystic ducts and these may unite before emptying into one bile duct in "Y" shape manner, or may empty separately as two distinct, separate, cystic ducts into the common bile duct.

Salient Features:—One gallbladder may be smaller than the other, or they may be of normal size.

They may be close together or widely separated.

One may be imbedded in the liver while the other lies in the normal gallbladder fossa.

Of the thirty-eight cases reported, twenty-one were in females; nine were in males, and the remainder, the sex was not noted. Of these thirty-eight cases, eight were of the bilobed type; six had a longitudinal septum, and two had a transverse septum. In all of these cases only one cystic duct was present, the arrangement being a "Y" shaped fusion of cystic ducts before emptying into the common duct.

Diagnosis is usually made at either operation or autopsy.

Conclusion

An additional case of gallbladder anomaly is presented in order that statistics may be enlarged, that relative rarity or incidence may be more accurately determined.

This case falls into Guyton's second classification in that there are two cystic ducts emptying separately into the common bile duct.

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"ANGINA DYSPEPTICA" SINE ABDOMINALIS AND "OBSTIPATIO SENILIS"

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Angina pectoris is the designation of the sensations of pain which patients with a troubled coronary circulation experience when exposed to effort. In the great majority of cases this pain is caused by sclerosis of the coronary vessels.

What will happen if a patient is affected with an isolated sclerosis of the blood vessels leading to the intestinal canal (the superior and inferior mesenteric arteries)? In the first instance the result will be a somewhat smaller supply of blood to the small and the large intestine. In the milder cases this decrease will hardly be able to produce any symptoms. In severer cases the blood supply during meals cannot help being affected, so that it falls to the intestine to perform the considerable task of conveying and resorbing the food with a deficient blood supply. This will naturally give rise to symptoms. If a comparison is made with the conditions obtaining in coronary sclerosis, it is to be expected that patients with a mesenteric sclerosis will develop abdominal pain of a dyspepsia-like character. If the sclerosing is more advanced the blood supply may become affected even between meals at the times when the intestine is most at rest. What will then happen? An organ whose blood supply is reduced works most satisfactorily when the rate is reduced. A poor blood supply to the intestinal tract must therefore be expected to bring about a reduced motility which in turn will result in constipation.

The proof of the above mentioned postulates will have to be furnished through the autopsy room, where the cases are collected in which there has been an isolated sclerosis of the abdominal aorta with efferent vessels, and a comparison made of the clinical findings and the autopsy findings. Such cases do occur but they are rarer than I expected them to be. That is why I want to publish my views, so that others may start collecting materials and the syndrome may be recognized.

If the cases of isolated sclerosis of the abdominal vessels have been collected, the observations may quickly be extended to include those patients in whom a more generalized sclerosis is present, and the symptomatology isolated with greater understanding. Sclerosis of the celiac artery will naturally also present special symptoms, since this vessel supplies the stomach, pancreas, spleen and liver with blood.

Case 1:—Male, aged 60. Admitted 18 October 1948, died 20 October 1948. (Record No. 1022). Formerly essentially well. From the age of about 50 the patient began to develop dyspeptic symptoms, manifesting themselves as pain in the epigastrium, which came on about 15 minutes after meals and lasted for about 1-2 hours. No eructations, heartburn, nausea or vomiting. The symptoms progressed somewhat during the first 2 or 3 years, after which time they remained stationary. At the same time, that is, when he was about 53, the patient began to suffer from constipation. The patient himself devised a regimen of smaller and more frequent meals. He overcame the constipation with linseed and paraffin oil.

His state of health was then satisfactory until he was 57 years old, when another type of severe pain developed in the epigastrium. This pain was more constant, often accompanied by vomiting. The pain progressed, there was loss of weight. X-ray examination in the outpatient department in 1946 showed a small niche situated on the upper part of the lesser curvature of the stomach. During the following two years he gradually became worse. He was practically moribund when admitted.

The clinical examination showed an emaciated icteric patient with a constant hiccough and dropsy.

Autopsy revealed a rather widespread cancer of the stomach, which had invaded the gallbladder, liver and pancreas. Whereas the ascending aorta, the arch and the descending thoracic aorta were practically free from any changes, the abdominal aorta was the seat of a fairly vigorous calcification located around the area where the mesenteric vessels originate and extending partly into these vessels. There were metastases in the pleura. Findings in the small and the large intestine were negative, as were those in the kidneys and renal vessels.

Summary:—A male patient is suffering from anginoid gastric distress with constipation between 50-57 years of age. At the age of 57 new symptoms develop, suggesting a serious affection of the stomach. The former period is looked upon as the symptoms of sclerosis of the abdominal aorta, while the latter is considered to represent the symptoms of cancer of the stomach.

Case 2:—Female, aged 67, admitted 1 September 1947, died 18 September 1947. (Record No. 902).

Well until the onset of the menopause at the age of 51. During the following 3 or 4 years there were increasing dyspeptic symptoms after meals. There was pressure around the umbilicus, developing in the course of years into rather severe griping pain with some tendency to meteorism. No eructations, heartburn, nausea or vomiting. No symptoms suggesting lesions of the bile ducts or kidneys. At the age of 56 or 57 the patient was troubled with hard stools because of a tendency toward constipation. From about the age of 60, walking and work caused some functional dyspnea. At the same time the patient began to have lighter meals in order to diminish the dyspeptic discomfort. Admitted for a severe pneumonia, patient died and autopsy revealed a marked sclerosis of the abdominal aorta and the superior and inferior mesenteric arteries. Apart from the changes in the lungs and a slightly granular state of the kidneys the autopsy findings were negative.

Summary:—An elderly woman develops gastric discomfort and constipation and, some years later, anginal heart attacks. Autopsy showed marked sclerotic changes of the aorta and of the abdominal blood vessels, and to a lesser degree, of the coronary arteries.

Case 3:—Female, born 12 July 1875. Admitted 11 June 1949, discharged 8 July 1949. Two normal deliveries. In 1908 the patient had the tubes and ovaries removed on account of "growths". In 1930 an attack of cholelithiasis; no attacks since. In 1946 a Colles' fracture.

Present Illness:—For 4 years anginal heart attacks radiating into the left arm. The pain comes on when she is walking and after meals. The last few months nocturnal attacks of dyspnea. Electrocardiogram in the out-patient department showed left-sided preponderance with Negative T_1.

During the last year before admission the elimination had been slow, for which reason the patient was treated with cathartic tablets. The last 6 months before admission tendency to meteorism and pressure in the epigastrium after meals, with rumbling.

The physical examination showed a fairly well nourished woman with a natural complexion and slightly cyanotic lips. There is arcus senilis. Weight, 49 kg. She wears a full denture.

Stethoscopy of the Lungs:—Negative.

Stethoscopy of the Heart:—Extensive impetus immediately outside the midclavicular line, nothing abnormal can be heard. The radial arteries are rigid. Slight tenderness to the left in the epigastrium but no resistances. There are small crural varices. The other physical and neurological examinations showed normal conditions.

Nitromannit has some effect on the cardiac trouble. During the study it is realized that a distinction has to be made between angina of a purely cardiac origin, provoked by exertion, and similar pain which appears after meals and is localized in the whole of the epigastrium. Strangely, the latter category of pain decreased after the institution of a regular treatment with pulv. alkalinus cum hyascyamo, but a real improvement only set in when the treatment was changed to a regimen of small but frequent meals of easily digestible food (pureed food). The bowels were regulated on linseed and paraffin oil.

X-ray Examination of the Colon:—Filling and emptying present a normal picture. There is a vigorous sclerosis of the abdominal aorta. X-ray examination of the stomach and duodenum: Negative. X-ray examination of the thorax: Heart and lungs normal. Some sclerosis of the aortic arch.

Electrocardiogram:—Left preponderance, with T_3 isoelectric.

Blood pressure, 90/100. Wassermann, Kahn and Meinicke reactions, negative.

Microscopic examination of urine taken with a catheter: nothing abnormal, no growth by cultivation on lactose agar. Hemoglobin (Sicca), 83 — 94 per cent. Sedimentation rate, 12 mm. Ewald's test meal + histamine, amout 20 + 134. The Congo test was negative; phenolphthalein, 3. Stools, no blood or mucus at five examinations.

Summary:—A 73-year-old woman has had a typical angina pectoris for 4 years. Furthermore she has arterial hypertension. For about a year elimination has been sluggish, there has been a tendency to meteorism and pain in the epigastrium after meals. The patient has an achylia which does not respond to histamine, and roentgenological examination reveals a sclerosis of the aortic arch and the abdominal aorta.

Discussion:—It is obvious that the abdominal anginoid attacks of pain only occur in elderly subjects, as the more pronounced forms of arteriosclerosis occur but rarely before the age of 50.

None of the cases reported in the foregoing are quite as I should have liked them to be, as the patients cannot be called patients for demonstration. Case 1 fulfilled the strict requirements as to a localized abdominal arteriosclerosis, but unfortunately the whole picture is masked by the cancer of the stomach. Case 2 is the most typical from a clinical point of view, since the patient had had abdominal symptoms (marked abdominal arteriosclerosis) for several years, and the last few years angina pectoris (mild sclerosis of the coronary arteries); but my requirements are the true, localized abdominal arteriosclerosis. Case 3 is clinical, and a closer examination showed that in this case too the symptoms from the heart coexisted with those from the digestive tract. The diagnosis of "angina dyspeptica" in this patient is made probable by the results of the treatment.

Even though I have not succeeded in publishing any perfectly "pure" cases of localized abdominal arteriosclerosis, verified by autopsy as well as by the clinical examination, I consider that the above mentioned three cases are so clear that on the basis of these an isolation of the symptom group "abdominal discomfort on the basis of abdominal arteriosclerosis" is justified, and again within this group the segregation of a subdivision which manifests itself by dyspepsia-like symptoms after meals, coexisting with purely intestinal symptoms such as meteorism. In contradistinction to patients with gastritis, these patients do not suffer from eructations, heartburn or nausea. I have myself chosen to designate this group "angina dyspeptica" to form an analogy of angina pectoris. The other group comprises cases of constipation which have developed in old age, and which, for the present, I have designated "obstipatio senilis"; but it might just as well have been called "obstipatio arteriosclerotica".

Treatment:—As the patients develop their gastric trouble after meals, it is clear that they will have to be treated accordingly as cardiac patients. An angina pectoris patient will stand still while he is having the attack, that is, he secures rest for the heart. The same is true for patients suffering from the gastric condition. They require small but frequent meals which prevent over-exertion of the gastrointestinal tract. Angina pectoris patients are treated with vasodilating medicaments. The same treatment is possibly practicable in the case of gastric cases. The results obtained in patients 2 and 3 are in favor of the correctness of the postulate and treatment.

The constipation requires treatment with filling and water-retaining remedies but certainly not with medicaments promoting the motility.

Summary:—A postulate about groups of symptoms to be expected in arteriosclerosis of the superior and inferior mesenteric arteries and the abdominal aorta is advanced. Three cases are reported which appear to support the correctness of this postulate. This adds to gastroenterology two new groups of symptoms, which at the same time belong in gerontology.

MASQUERADING ESOPHAGEAL LESIONS*

Clinical Phenomena of Transferred Abnormal Effects Possibly Due to Vagovagal Reflexes

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Sudden death on the operating table in the course of simple routine surgical, endoscopic, or anesthetic procedures shocks all concerned into profound awareness of the force of vagovagal reflexes.

The lack of satisfactory working understanding of these vagovagal phenomena may have obscured their vast clinical significance. We are all aware of many of the extremely complex *physiological* interrelationships between the gastrointestinal, cardiovascular, and respiratory systems through the autonomic nervous system. Perversion of these relationships with what will be called *transferred abnormal effects* through the autonomic system are more varied, less common, and therefore less well understood. However, within the limits of our understanding, they are none the less predictable.

These relationships in disease have received attention in sporadic case reports for twenty years. Our attention has been focused because we have recently seen angina pectoris associated with lesions of the stomach, heart block from esophageal irritation, and laryngospasm or asthma secondary to diaphragmatic hernia. These are not instances of the symptoms of one condition being *confused* with another, nor as pain *referred* from one site to another, but rather of one condition *causing* another. In these instances, the vastly complex vagus nerves would appear to act as the transfer mechanism. It may therefore be permissible for the sake of clarity and emphasis to create this descriptive term, *transferred abnormal effect*, to distinguish sharply these phenomena from *referred pain*. *Referred pain* is a symptom of distant disease. *Transferred abnormal effect* is a disease caused by distant disease.

A few illustrative cases form the basis for this discussion. A single, simple gastrointestinal lesion, esophageal hiatus hernia, is used as the hidden or masquerading primary site causing varied distant disease patterns. The variety of other lesions that can initiate remote abnormal clinical effects would appear to be great. They assume an order of prime importance to the surgeon, internist, and anesthesiologist.

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Historical Background

Much has been written about viscerocutaneous or referred pain mechanisms. There is incomplete understanding of the physiology of referred pain but at least clinicians are cognizant of its clinical vagaries and utilize referred pain patterns in diagnosis. The early paper of Dana[1] and the classical articles of Head[2], Ross[3], and Mackenzie[4] form the basis for such knowledge. On the other hand, in our experience, the vagovagal reflexes have not been so widely understood either in basic physiology or clinical pattern.

Morgagni[5], in 1769, first associated anginal symptoms with diaphragmatic hernia. Von Bergmann in 1932[6] attempted to correlate hiatus hernia with heart action. His so-called "gastrocardiac complex" presumed that the hernia caused pressure on the vagus fibres with consequent reflex disturbances of the coronary circulation.

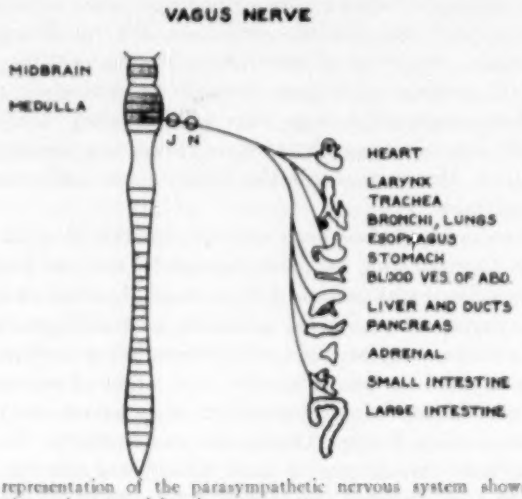

Fig. 1—Schematic representation of the parasympathetic nervous system shows the thoracic and abdominal viscera innervated by the vagus nerve.

The medical literature contains a number of clinical and experimental observations that demonstrate cardiac disturbances with esophageal and gastric distention and contraction. Jackson and Jackson believed that air, trapped in the stomach and esophagus, resulted in anginal pain, but that this pain was not related directly to the heart[7].

It has been suggested[8-11] that distention or irritation of the esophagus might cause cardiac irregularities and pain resulting from coronary constriction and myocardial ischemia. These writers believed that the coronary blood flow was affected through vagovagal reflexes. Jones has provided the most complete review of the relationship between anginal pain and hiatus hernia[12,13].

One of the earliest and best descriptions of the syndrome of *transferred abnormal effect* with which we occupy ourselves, is that of Weiss and Ferris in 1934[14]. They described the case of a 64-year old man brought to their attention when he

attempted suicide because of frequent fainting attacks precipitated by food swallowing. He was shown to have a traction diverticulum of the esophagus. During attacks, he developed bradycardia and heart block with Adams-Stokes syncope. The trigger site for this sequence was unquestionably the esophagus, as it was possible to produce the attacks by distending a balloon in the esophagus at the level of the diverticulum. The reflex nature of the syncope and its relation to the vagus nerve was established in a number of ways. First, the subcutaneous injection of 1 milligram of atropine counteracted the effect of inflating the balloon. Second, interruption of the vagus pathways by procaine infiltration of either vagus trunk just below the level of the carotid sinus prevented the heart block and syncope. Weiss and Ferris described other patients with no demonstrable pathological processes in the esophagus who developed cardiac arrhythmia and fainting on swallowing.

Cardiac slowing and syncope have been shown to follow vagal stimulation from other causes. These include bronchiogenic carcinoma with recurrent nerve paralysis[15], pressure on the sinus piriformis[16], and cardiospasm[17].

The tragedy of cardiac or respiratory arrest associated with manipulation of organs innervated by the vagi has been observed repeatedly in surgical clinics[18]. The arrhythmias observed during vagotomy or esophageal surgery have led to the use of vagal novocaine block or intravenous atropine as a prophylactic measure. Alterations in cardiac rhythm, presumably on the basis of vagal stimulation, have been noted following gaseous eructations, nausea and vomiting, the passage of gastric tubes, bronchoscopes, and endotracheal tubes, and simple deep inspiration[19]. There are even reports of cardiac arrest following the insertion of a stomach tube[20]. Another form of gastrocardiac effect may be sudden death ascribed to acute dilatation of the stomach[21].

Perhaps the earliest use of direct cervical vagus nerve block by the anesthesiologist as an aid in intrathoracic surgery was that of Burstein. This work was documented electrocardiographically by Zoll[22].

These miscellaneous clinical and therapeutic notes indicate that many men have been concerned about vagovagal reflexes for many years. If physicians generally could share this concern, it would act to the great advantage of their patients and we might advance rapidly in better understanding of these phenomena.

Vagus Nerve Pathways

Parasympathetic afferent fibres run centrally in the vagus to the nodose ganglion that contains the cell of origin. Impulses follow vagus channels to the fasciculus solitarius and end in the nucleus of the tractus solitarius on cells that send motor fibres to motor nuclei. Medullary centers are essential in these reflex patterns. There is no evidence to support earlier beliefs that a vagovagal or viscerovagal reflex can exist on the basis of an overflow phenomenon from afferent esophageal impulses leading to the cardiac or pulmonary plexuses (Fig. 1).

Visceral afferent pathways to the vagal medullary centers apparently may be sympathetic or parasympathetic. The type of stimulus may determine which path is taken. Pain is mediated by way of the sympathetics, particularly the greater

splanchnic nerves, to the sympathetic ganglions and thence to the spinal cord, so that referred pain follows a segmental pattern from the thoracic spinal nerves. Other stimuli such as distention, increase in intramural tension, increase in intraluminal pressure, or the changes in gastric acidity appear to be carried in afferent fibres in the vagi to higher centers. Similarly, the efferent limb of the reflex may be sympathetic or vagal, but experimental evidence suggests that it is predominantly the latter. Therefore, afferent stimuli from the esophagus and abdominal viscera, regardless of the route to the vagus center, may result in vagal motor effects on both thoracic and abdominal structures. Apparently, bronchospasm, coronary constriction, or heart block can be the *transferred effects* of such autonomic reflexes.

Vagal effect on the coronary vessels is not yet clearly defined, but there is evidence to indicate that it is constrictor in action[23]. Gilbert, Fenn, and LeRoy[24] present evidence to show that experimental distention of the stomach, especially the

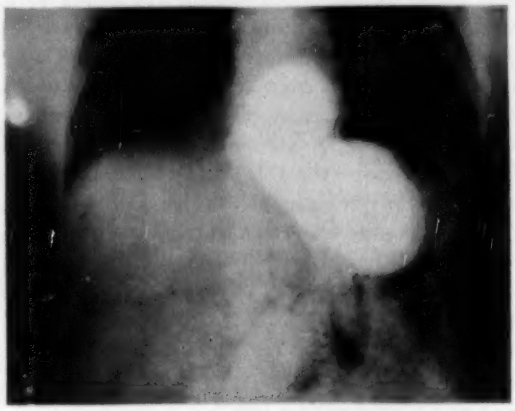

Fig. 2—Roentgenogram of large esophageal hiatus hernia.

cardia, results in a decrease in coronary flow in dogs. This response does not follow the administration of atropine or vagus section.

It would appear that *normal* visceral interrelationships mediated over autonomic networks may become perverted. In the presence of disease at one or both ends of the arc, an *abnormal* stimulus arising from a diseased part may produce an abnormal effect. This can be conveniently described as *transferred abnormal effect*.

Procaine block of the vagus nerve in the neck as the nerve emerges through the jugular foramen at the base of the skull has proved to be a useful maneuver in evaluating patients whose symptoms may be explained by abnormal vagal stimulation. The technic is easily mastered and can be accomplished in bed with minimal discomfort to the patient.

After making a subcutaneous wheal with 1 per cent novocaine or metycaine near the angle of the mandible at the base of the ear, an ordinary #20 or #21 gauge spinal needle is directed upward and backward at 45° angles between the

mastoid bone and styloid process. As the needle is advanced, the tissue is infiltrated and frequent aspiration is done to prevent intravascular injection. The vagus nerve runs in the carotid sheath between the jugular vein and internal carotid artery and posterior to both. The appearance of blood in the aspirating syringe may be a guide for determining position of the needle tip. The area in the vicinity of the jugular foramen is bathed with 30-40 c.c. of dilute procaine; sufficient anesthetic agent reaches the vagus trunk to interrupt nerve impulses. Successful vagal block is demonstrated by hoarseness (recurrent laryngeal nerve) and unilateral anesthesia of the pharynx. Block may be done bilaterally with impunity (Fig. 2).

Case Reports

The following three patients are presented to demonstrate a variety of transferred abnormal effects; i.e., heart block, angina pectoris, asthma, and laryngospasm, arising from simple diaphragmatic esophageal hiatus herniae. Vagovagal reflexes would appear to be the transfer or projection mechanism.

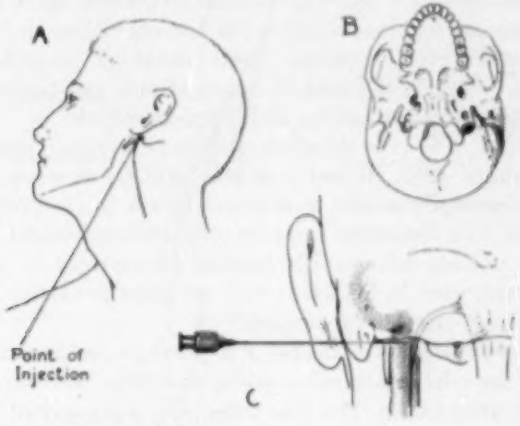

Fig. 3—Sketch to illustrate high vagal block.
A. Point of injection between mastoid and styloid.
B. Base of skull shows bony landmarks and jugular foramen through which the vagus nerve leaves the cranium.
C. Needle in situ, viewed from behind. The carotid artery and internal jugular vein are in close apposition to the vagus nerve.

Case 1:—E. R.,* a 70-year old mother of eight children, was admitted to the hospital in June, 1947. For fourteen months prior to entry, she had suffered squeezing pain over the lower third of the mid-chest and upper epigastrium. This pain lasted from one-half to one hour and was aggravated by food ingestion, but not by activity. During the same period, the patient had frequent episodes during which she was aware of marked slowing of her pulse followed by fainting. She had had no dyspnea, orthopnea, ankle edema, hemoptysis, or hematemesis. At the onset of her symptoms, the diagnosis of coronary thrombosis was made, and the patient kept virtually bedridden for over a year.

*Referred by Dr. Burton E. Hamilton, Boston, Massachusetts.

Past history, family, and social histories were noncontributory.

Physical examination revealed an obese elderly woman in no distress. Examination of the heart and lungs was not remarkable. Her blood pressure was 160/110. Laboratory studies of blood and urine were within normal limits. The presence of an esophageal hiatus hernia of the stomach was revealed by upper gastrointestinal roentgenographic studies. When distended, the supraphrenic portion of the stomach measured approximately 9 x 10 x 10 cm. (Fig. 3).

Because of the patient's age and past history, direct definitive surgery on the hernia seemed formidable and it was elected to try a temporary left phrenic crush as palliative treatment first. This was done on 6/28/47.

After this procedure, there was dramatic remission of both pain and the episodes of bradycardia with syncope for a period of nearly five months. At the end of that time, however, the substernal pain and fainting recurred. Fluoroscopic examination revealed that the left leaf of the diaphragm was again moving in an orthodox manner. The temporary paralysis afforded by phrenic nerve crush had disappeared. Therefore, she was readmitted to the hospital where, on 11/19/47, permanent interruption of the left phrenic nerve was carried out. Since that operation, the patient has been very well, and completely free of pain and fainting. She has been able to carry on her household duties and travel extensively.

Case 2:—E. M., a 47-year old white male hospital orderly was admitted to the hospital in February, 1948. He had been well until six or seven months prior to admission when he began to have shortness of breath on exertion, after eating, or when lying down. The discomfort came on ten or fifteen minutes after eating and lasted for thirty or forty minutes. His dyspnea accompanied by audible wheezing frequently occurred when he lay flat in bed and often awakened him from sound sleep. These symptoms cleared on standing.

Coincident with the onset of the two symptoms, he had noticed a nonradiating midline pain in the inferior anterior thoracic and upper abdominal regions. This came on shortly after eating. This discomfort was accompanied by nausea, was exaggerated in the recumbent position, and was relieved by vomiting. The patient had a cough productive of frothy purulent sputum, most abundant on arising. There was no history of hemoptysis, hematemesis, melena, abdominal cramps, or jaundice.

The past history was apparently irrelevant except that he had had pneumonia three times in the past. About seven months prior to admission, he had been struck on the lower part of the chest during an automobile collision.

Physical examination revealed a well-developed, well-nourished man who breathed easily when upright but was dyspneic in the recumbent position. Wheezing was audible throughout the room when he lay flat in bed. There was no distention of the neck veins nor change in color. The dyspnea and wheezing ceased when the patient stood for ten or fifteen minutes.

The significant physical findings were limited to the lungs. Scattered moist rales, rhonchi, and sibilant and sonorous rales, both inspiratory and expiratory, appeared almost immediately on assuming a recumbent position and cleared when the

patient was upright. There was no change in the percussion note, tactile or vocal fremitus.

The temperature was 98; pulse was 84; and the blood pressure was 130/90.

Blood studies and urinalysis were within normal limits. The electrocardiographic tracing was normal.

X-ray examination of the gastrointestinal tract revealed an esophageal hiatus hernia. Under the fluoroscope, a remarkable train of events could be followed. When the patient was given a carbonated beverage, the supraphrenic portion of the

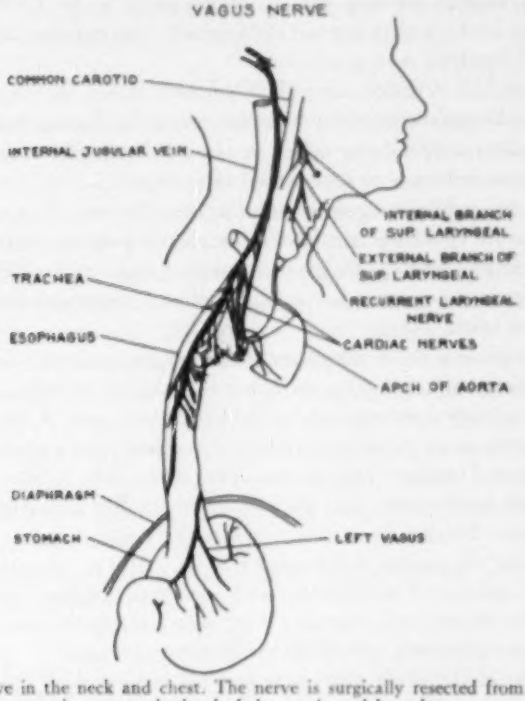

Fig. 4—Vagus nerve in the neck and chest. The nerve is surgically resected from the take-off of the recurrent laryngeal nerve to the level of the esophageal branches.

stomach became distended and increased the size of his hernia. Concomitantly, asthmatic breathing resumed.

The relationship between this hiatus hernia and the patient's asthma would appear to be definite. It is unfortunate but understandable that he is not enthusiastic about further studies. These would include trying to produce asthmatic attacks with the vagus nerves blocked with procaine. This has been recommended, with the view toward surgical repair of the hernia.

Case 3:—M. W.* a 62-year old white housewife was first admitted to the hospital during March of 1947. She had been under treatment for bronchopneumonia

*Referred by Dr. Horace P. Stevens and Dr. Fred R. Jouett, Cambridge, Massachusetts.

at home for several days. On the day of admission, she had a sudden onset of pain in the front of her chest and upper abdomen, greater on the left side. Nausea and vomiting accompanied the pain. The diagnosis on admission was acute coronary thrombosis.

Physical examination on admission revealed a woman suffering acute and severe substernal and upper abdominal pain. Examination of the heart and lungs revealed no abnormalities. Blood pressure was 160/40. The abdomen was soft and not tender.

Laboratory studies revealed the red blood count to be 3,850,000; the white blood count was 7,900, with a normal differential. The sedimentation rate was 45 mm. per hour. Urinalysis was negative.

Roentgen studies revealed several cholesterol stones in the gallbladder. An 8 x 6 x 5 cm. diaphragmatic hernia was demonstrated by fluoroscopy.

Repeated electrocardiograms taken at two-day intervals were all reported to be normal, without evidence of myocardial infarction.

In view of the evidence against acute myocardial infarction, it was hypothecated that this acute episode might have been angina pectoris, secondary to distention of the herniated stomach, mediated through a vagovagal reflex. This assumption gained subsequent support by a more definite vagovagal mechanism in the following clinical crisis.

Following a phrenic crush the patient had complete relief for six months. However, in September, 1947, following an upper respiratory infection accompanied by dry cough, she developed severe, right-sided abdominal pain. A few days later, she began to experience acute paroxysms of this abdominal pain associated with cough, marked dyspnea and stridor when she was lying down. The stridor and difficulty in breathing became so dramatic that friends called the fire department, seeking aid from a resuscitator. She was then readmitted to the hospital.

On admission, the patient was having frequent attacks consisting of cough and abdominal pain, associated with stridor and a marked tracheal tug. Slight tenderness and increased abdominal resistance were noted during the paroxysms although the abdomen was completely soft in the cough-free intervals.

Examination of the heart and lungs was not remarkable. The blood pressure was 140/60.

Laboratory studies revealed the red blood count to be 4,100,000 with hemoglobin 81 per cent of normal. The leucocyte count was 13,000 with 51 per cent polymorphonuclear cells. Urinalysis was negative. The electrocardiographic tracings were normal.

Two comments taken from the hospital record are of interest: "Mrs. W. had an attack shortly after breakfast. She was lying comfortably in bed when there was a sudden onset of striking inspiratory dyspnea and stridor. She was assisted to a sitting position with some relief. After a minute, she vomited perhaps an ounce of coffee-colored material and the attack terminated as rapidly and abruptly as it had commenced." The second comment indicates that a vagovagal mechanism was sus-

pected: "This patient is having attacks of spasmodic dyspnea often brought on by talking. During these attacks, she has great difficulty in getting her breath and there is severe stridor. I believe these attacks are due to laryngeal spasm. With the attack, she becomes slightly cyanotic. Her lungs are clear. I believe that it is possible to explain these episodes as reflex effects from the diaphragmatic hernia."

Soon after admission, the patient was started on atropine, following which she had no more laryngospasm. It was concluded that the hernia was the initiating factor in this patient's crises.

On 9/25/47 the diaphragmatic esophageal hiatus hernia was repaired through the transthoracic approach. Since operation, she has been completely well.

Comment

When interest is focused on any condition its incidence appears to increase and its significance is emphasized or even exaggerated. We have come to look upon asthma and cardiac irregularities as frequent associates of hiatus hernia and other esophageal disease. This emphasis has been wholesome in that it has extended our diagnostic and therapeutic horizon in several instances (Fig. 4).

It is now easier to understand why true diffuse bilateral asthma occasionally improves after the extirpation of localized disease. Bronchiogenic carcinoma and bronchiectasis are noteworthy examples of such intrapulmonary disease. Cholelithiasis and duodenal ulcer are additional examples of distant disease.

It is through this interest in vagovagal phenomena that we have utilized procaine vagal block as a tool in the study of asthma. This has helped us interrupt severe status asthmaticus. It has also enabled us to select two groups of patients for surgical treatment. In one group we have corrected a distant pathological lesion. In the other, in which both limbs of the reflex arc seem to lie within the lung, we have performed direct vagectomy (diagram).

These thoughts have led us to look again at a number of patients, particularly in the asthma and cardiac clinics.

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Discussion

Dr. Edwin Boros (New York, N. Y.):—I am quite pleased at the opportunity of having listened to Dr. Harken's interesting paper. His contribution embraces a consideration not merely of local manifestations as they involve the esophagus proper but also embodies concepts of regions beyond.

This is quite gratifying because he is operating in a field which is most difficult and formidable.

Our knowledge of the esophagus dates back many centuries, and yet progress in the development of present concepts has been relatively slow. Anatomically as well as physiologically, this indispensable organ lies in a cage which is surrounded by important structures. It is locked in, as it were, by the tonically closed cricopharyngeus muscle above, and the diaphragmatic closure below, and therefore does not lend itself readily to investigation and progress. Thus nature itself has contributed to the retardation of knowledge of this structure.

About seventy-five years ago, some adventurous workers collaborated in a method by which they hoped to be able to unlock this organ. Their work culminated in the establishment of endoscopy as a means by which this could be accomplished. Taking part in these endeavors there was a gastroenterologist, a surgeon, and later a laryngologist. Later the aid of a roentgenologist was invoked. With their combined help and that of the clinician and surgeon, our present knowledge became crystallized. Development, however, did not keep pace satisfactorily. Were one to gauge and appraise the sum total knowledge of this organ in terms of pages and chapters, one will find that by comparison with other organs of the digestive tract, it appears in a somewhat reduced state.

Dr. Harken's work opens up broad channels of study which offers considerable encouragement. Unfortunately, instrumental diagnostic study of the swallowing tube has been restrained and restricted. The procedure for the most part has been in the hands of the laryngologist. The average physician and surgeon shrinks when confronted by the thought of instrumentation of the esophagus and in no small measure has such an attitude in the past been justified. Nor has the patient himself shared a different feeling in the past.

A few days ago, Lord Webb-Johnson spoke of the "Dark Ages" which prevailed in medicine in medieval days, and which with the help of God and the physician evolved into a broad general development which was soon reflected in its many forms in both medicine and surgery. If one might at this moment evaluate the present state of our knowledge of the esophagus, it might properly be considered as being in the twilight zone. And so, if we are to make progress which good leadership and combined cooperation permits, we must be attuned, we must be ready to accept the newer developments which some of us at times are a little hesitant to accept, and if we are to investigate and evaluate and add further to the admirable work which Dr. Harken and his associates have done, the means are available at the present time by which we can do so. Today, with the use of the flexible esophagoscope, we have the key not only for the investigation of this organ's behavior but also for the conduct of treatment never before envisaged. It remains for the student of medicine, the clinician and surgeon to exploit these resources along new avenues and possibilities.

It has been asked, how intense is the actual need for instrumental esophageal exploration? Can it be performed routinely? The answer depends upon what one has in mind. If one desires to investigate, complete freedom and safety is assured with ease to the patient. Where one wishes to treat, facility of manipulation is afforded. For more concerted and expansive surgical endeavor, the operator is spared the ordeal and dangers of past experiences.

May I express my gratitude for the opportunity of being here and discussing Dr. Harken's and his associates' most interesting paper.

Dr. Hyman I. Goldstein (Camden, N. J.):—The neurophysiology of the esophagus was ably presented, by one who has made an extensive study of the subject. Perhaps the speaker will make some comments on "achalasia of the cardia", "ingluveosis" or "preventriculosis".

Reference might here be made to Thomas Willis' report on "cardiospasm" and his treatment by dilatation; Hannay's "achalasia"; Hurst and Rake on "achalasia"; T. Purton, "achalasia", and the discussion by F. Wild: Ueber die peristaltische Bewegung des Esophagus, nebst einigen Bemerkungen über diejenigen des Darmes, Max Einhorn (1888), H. Mayo and others. F. Hoffmann (1733), Purton, Mayo, Hannay, Willis (1672), and Rudolpho Augusto Vogel observed esophageal and cardial "spasm", or more correctly, *ingluveosis* or achalasia!

There is no true anatomical sphincter at the lower end of the esophagus—where it joins the "cardia". The condition of so-called "spasm" here—is a failure of

the orifice to open, rather than a spastic sphincteric "strictural" closure. The term ingluveosis, or preventriculosis—or achalasia of the cardia—as suggested by Perry and Hurst, is more accurate than "cardiospasm".

Finally, may I call to your attention Avenzoar's "*Quod est privatione sensus et motus relaxatione meri esofagi*" wherein he reports the use of silver and tin cannulae in the esophagus—in obstruction and/or spasm of the esophagus, to feed the patient! Of course, as you know, he discussed "Veruca stomachi" (cancer of the stomach) and cancer of the esophagus—and "de passionibus stomachi", and "*de veruca que oritur stomacho*".

Dr. Dwight E. Harken (Boston, Mass.):—It has been nice to have the stimulating comments of Drs. Boros and Goldstein.

Dr. Boros has done more than one man's share to make esophageal investigation practical, possible, and reasonably comfortable. Through his efforts and those of men like him, esophageal examinations are no longer dreaded ordeals.

I am not a very old surgeon, but I have lived long enough to see a number of those ordeals become simple examinations. I can recall when sigmoidoscopy was an affair of deep anesthesia and multiple enemata, with a surgeon standing confused and in sterile garb, inspecting cascades of fluid feces, and seeing nothing. We have now passed into an entirely different era so far as that simple examination is concerned, and now we have similarly taken on a very practical, simple era of esophageal examination. Our examinations have been standardized to the point where they can be carried out in the patient's hospital room or the outpatient department. In the proper hands, even the nonflexible esophagoscope can be used to pack the bleeding varix. I believe these forms of investigation have taken us beyond the twilight zone in examination of the esophagus.

It is very nice to have Dr. Goldstein ask about cardiospasm and call it achalasia, because it is neither cardiac nor spasm, the etiology of which I certainly cannot describe, but concerning the treatment of which I have reached a very definite attitude. I believe it is the exception where surgery is necessary, and that the bag dilatation has now become a completely satisfactory form of therapy except in those instances where we are uncertain of a neoplastic factor. I can well imagine that one day, again, as within the past three weeks, I will see one or two patients with apparent cardiospasm in whom I will be suspicious of neoplasm. Then surgical procedure will be carried out, with the plastic operation as the treatment of choice.

On scleroderma—again I cannot venture into a discussion of the etiology. The pathologic factors and pictures are well known to you. The treatment so far as I am concerned is only symptomatic, namely, the handling of the stricture by frequent mercury bouginage, and the repeated use of the Jackson dilator or bags, beginning, if the lesion is specific, in one or more areas.

I have seen only three patients suffering from scleroderma. For that reason I cannot boast an adequate experience for comment on your question.

The query as to carotid sinus reflexes, I will simply duck. I cannot answer the question.

It is not surprising to me that we can trace an interest in the esophagus back nine hundred years. There are certain things that are always with us or we are without life. In those factors we can expect a sustained interest on the part of those who minister to the health of others.

In closing, and in all seriousness, I should like to say that I had no idea there would be anybody here this late in the evening to hear a physiologic discussion of lesions of the esophagus. I think that whether or not you have heard what you wanted to hear is beside the point; your presence speaks well for the seriousness of the National Gastroenterological Association.

POSTOPERATIVE PREVENTION OF ANAL STENOSIS

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Most standard texts on proctology are found to advocate the use of liberal amounts of mineral oil following anorectal surgery for the purpose of keeping the stools soft and making their passage easy. In those cases where radical hemorrhoidectomy has been performed or where the excision of anal skin has been extensive as in combined hemorrhoidectomy and fissurectomy, or in other similar procedures, there is a great need for repeated dilatation of the anal canal during the healing process to prevent the development of stenosis. It is mainly to these types of cases that this paper alludes.

It has been my observation that the use of mineral oil results in a soft to loose stool which has no dilating effect whatsoever upon the recently operated anorectum. Should this state continue throughout the healing process, it is almost inevitable that the anal canal will heal in a narrowed condition. Then, when mineral oil is discontinued and the stools once again become the normal inch or more in diameter, the patient experiences difficulty in trying to pass this size stool. Thus, chronic constipation may ensue. In addition, if the stool is firmly formed, it cannot mold sufficiently and the anal skin may split and true fissure formation with its attendant distressing train of symptoms may follow.

Many operators say that if the examining finger is passed into the rectum between the 7th and 14th days postoperatively, there is little danger that stricture or stenosis will occur. However, I have found that the edges of the incisions will agglutinate together in as short a time as three to five days; that by even the seventh day, this cannot be broken up digitally without causing extreme pain to the patient. This can be avoided either by passing the finger on the second or third postoperative day, or by allowing the passage of a well-formed stool by the third postoperative day. Following this, if mineral oil should be continued, dilatations must be carried on diligently about every two days in order that the anal canal heal to fairly normal calibre.

There are those cases where the patient has a history of chronic constipation and the habitual use of laxatives. In such cases, a hydrophilic colloid (metamucil, mucilose or konsyl) should be given as this will be found to materially aid in regulating the bowels and keeping the stools bulky and well-formed. It is common knowledge that a well-formed stool is far less irritating in its passage through the anal canal than is a loose stool.

The method I have found to fit most of these cases is to pass the gloved index finger into the rectum on the second, or at the latest, the third postoperative day, not to dilate but merely to separate agglutinations. This can be done with very little discomfort to the patient if performed slowly and gently with an anesthetic ointment as the lubricant, while having the patient lie in the lateral or Sim's position. This separation of agglutinations is done merely to make the subsequent passage of the

first stool easier. To further facilitate the passage of the stool, any cocoa butter suppository may be inserted at the same time. This will melt rapidly and coat the forepart of the oncoming stool, resulting in a practically painless and easy motion. At the passage of this first stool, the anal canal receives its first postoperative dilatation, the subsequent ones occurring at each passage of normal stool. These dilatations prevent primary union and keep the wounds open, thus allowing the epithelium of the anal canal to creep across and cover these areas, the final result being a normal canal with sufficient epithelial lining to allow a normal range of distensibility and flexibility.

CORTICODIENCEPHALIC GASTROINTESTINAL SYNDROMES IN EPILEPTICS*

(Part X)

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Case Reports

The first of the two cases which we wish to cite is a woman by the name of C. S. This patient was first admitted to the institution in August of 1927. Although her chief complaint consisted of epilepsy, she suffered from special attacks of abdominal pain associated with nausea as well as other symptoms. These attacks occurred independent of convulsions and sometimes preceded them, in the form of an aura or prodrome. In the course of her stay at the institution, it was found that aside from the above two main complaints, she suffered from other conditions which strongly reflected upon the etiologic character and mental as well as physical constitution of her case. Upon admission it was noted for instance, that she had a male child three weeks old whom she could not care for. Various other notes in her records showed items such as chronic bilateral otitis media. Another finding which was mentioned a number of times, was that she suffered from a systolic murmur at the apex. Although her attacks were variable, as will be shown later, it was stated on a number of occasions that these occurred not infrequently at bed time, and were associated with loss of consciousness and loss of memory after being preceded by nausea and vomiting. Aside from the abdominal complaints the most persistent feature about this patient is that she becomes periodically psychotic and is emotionally unstable most of the time.

Her case history, as gathered from the commitment records and other papers, shows that she was 30 years of age upon admission. At that time she could read and write and had clean habits. The form of epilepsy was given as petit and grand mal, which occurred nocturnally as well as diurnally and was caused by illness responsible for the loss of her first baby. The duration of epilepsy upon admission which was in 1927, was given as eleven and a half years.

It was also stated that it was rather difficult to obtain a history from her, because she was described as being slightly deaf. The first attack was said to occur at 19 years of age, when she frothed at the mouth and was completely incapacitated

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for 20 minutes thereafter, subsequently suffering from a broken nose. The second attack took place two or three days after the first one. Upon admission her memory was found to be affected and she said that someone is always chasing her. Her moods alternated between excitement and depression. She was found to be quarrelsome, irritable and unmanageable. We attempted in the foregoing pages, to show how the hypothalamus is directly or indirectly involved in cases of epilepsy. By direct involvement we mean dilatations of the third ventricle. By indirect involvement we refer to descending degeneration, of such fibre pathways the neurone chains or collaterals of which connected with the hypothalamus or tuber cinereum. It might not be irrelevant to stress the fact that Morgan as well as a few other authorities found lesions in the hypothalamus of patients suffering from psychoses. We are not familiar enough with their work to state whether their data dealt with the organic psychoses or dementia praecox and the like. Although we are interested in describing visceralgic and visceresthetic syndromes, it might not be irrelevant to state that in institutional and noninstitutional epilepsy cases we see psychoses as well as acromegaly coming on late in the disease. What this phenomenon indicates we are at a loss to explain.

The first physical examination showed the patient to be 5′ 3″ tall and weighing 141 lbs. Her head was described as large with particularly prominent parietal eminences. Her reflexes were described as normal. The only outstanding feature about her examination was that she suffered from deafness associated with a hole in her right tympanum. Her blood pressure was given as 120/80. Her pulse rate was given as 60. Although muscle strength was normal the pyramidal or extrapyramidal abnormal involuntary movement, consisting of a fine intentional tremor of her extended fingers, was described. The blood count showed a 90 per cent hemoglobin, a red cell count of 5,700,000 and a white blood cell count of 6,400. During her stay at the institution she sustained minor bone injuries as a result of falls during seizures.

Other than the above, the records of her family history as well as the menstrual histories were uncontributory. Additional laboratory studies such as that of the spinal fluid Wassermann and others, were all done from time to time and were shown to be negative. From all of the above data which was mostly of a negative nature, it became evident that we were dealing with a patient who was not suffering from a brain tumor, brain syphilis, multiple sclerosis, extrapyramidal disease, brain hemorrhage, thrombosis, brain injury or other brain and spinal disease causative of convulsions other than some sort of infectious or toxic process of the brain or its covering. It was felt that the serology and other laboratory studies ruled out brain syphilis and tuberculosis of the brain and its coverings. The blood picture and blood chemistry ruled out diabetes, hypoglycemia, uremia or polycythemia. The clinical picture ruled out the other conditions mentioned above excepting brain tumor. The absence of papilledema, persisting headache and x-ray evidence of increased intracranial pressure did away with the last mentioned en-

tity as a causative agent of the convulsive episodes or of the gastrointestinal syndrome. It may be that intestinal worms could cause convulsions but as primary agents causing brain lesions we felt them to be innocuous. Whether this long standing brain disease was due to some infectious process or some toxic condition incidental to her pregnancy, was never determined. She was described as suffering from frequent attacks of the grippe and various examinations showed that she suffered from a deflected septum as well as from recurrent discharges from the hole in her right tympanum. The clinical picture did not suggest brain abscess and neither did the progress of the symptom or the appearance of the regions adjacent to the middle ear.

Various descriptions taken from the progress notes of her case record will give an insight into her personality make-up. She seems to present a periodic type of emotional behavior reaction. In 1928 she was said to suffer from such psychotic periods which lasted two months at a time during which she was stubborn, excitable and easily angered, refusing to do work and being profane and abusive. The 15 convulsions per month were unrelieved by 1½ grains of luminal daily. In 1929 she would do between 2 and 3 hours of work a day during the first part of the year. Even then, she was invariably talkative and constantly complained. Towards the latter part of that year and during 1930, she occasionally required the use of a continuous bath, because of her attacks of mental disturbance. Due to the above, she was described as emotionally unstable and classified as a deteriorating epileptic. The foregoing descriptions are still being applied to her even at present, except that her mental and emotional deterioration are said to have progressed, as compared to that noticed on her admission. Although we propose to refer to therapy in specific cases in the future, we wish it to be understood now that such remarks are not to be taken seriously, even though reference is made to results obtained by us. In the first place, we are uncertain about the actual specific drug indicated in the gastrointestinal symptoms. Even the treatment of the convulsion is fraught with many hindrances. Our experience along these lines has been with phenobarbital in patients in city hospitals as well as in hospitals that are not governmental. Clinic patients of the epileptic type are usually of the poor class. Some of these rely upon the Department of Welfare for their support. Eventually, the obtaining of sufficient funds for food becomes the main object of regular attendance at the epilepsy clinic, where the epileptologist has to pass upon their inability to work because of seizures. If such patients do not obtain the amount of medication prescribed, they will not report it. They also fail to report alcohol indulgence, dietary irregularities, etc. For these reasons we wish that our remarks with regard to the above not be taken as final.

The following reports of the x-ray findings on the stomach and intestines of the above patient will illustrate the difficulties which one encounters not only in diagnosis of such cases, but in the treatment as well. The findings in this case which will be accompanied by definite illustrations, resemble those which we will

present in another patient whose abdominal complaints were much more troublesome and who was really a great problem in therapy. The following records of the gastrointestinal series were submitted in February of 1939. Films were taken every half hour. No abnormality of duodenal cap nor of emptying time was noted. Some evidence of fecal stasis was observed in the cecum and in the first parts of the transverse colon and the characteristics of distention of the descending colon throughout its entire length. Another x-ray report of the gastrointestinal series of this patient was made in February of 1945 (Fig. 68). This report showed that the esophagus was negative. The stomach was large and its muscular tone and activity were noted. The pylorus seemed to remain open most of the time. No signs of

Fig. 68

organic lesion were noted. The emptying of the stomach was found to be rapid. The duodenal lumen was considerably larger than is usually seen (Fig. 69). Although the roentgenologist reported that there was no evidence of gastric abnormalities to cause the gastric symptoms, it can be readily seen, that what seemed to be a functional disturbance in the sphincters, could account for a great deal of the digestive disturbances and therefore cause secondary symptoms. From the work of Watts and Fulton and from the records of extensive disturbances in muscle tone of the gastrointestinal tracts of epileptics as presented by Lennox and Cobb, it can be readily seen, that muscular disturbances such as presented above indicate not only interesting secondary neurogenic syndromes, but also suggest a tremendous therapeutic problem in epilepsy.

We shall, in the next case, dwell at length, on the problem of therapy. Since this problem involves, as will be seen, the use of various autonomic drugs, the question will eventually come up as to whether drug therapy is a solution to the alleviation of symptoms in this as well as the next case; and, in fact, in most of our patients who present abdominal complaints consisting essentially of pain. The questions to be decided, are not only those between drug therapy and surgery, but also, should the latter be decided upon, should it consist of the abdominal variety of surgical interference, treatment of the autonomic via paravertebral blocks, and ganglion resections, or, is it necessary to perform craniotomies in most of these patients; and if so, might not a combination of all of the above be tried. Although we have expressed our opinion that there are a number of cerebral centers which control gastrointestinal function, and that all of such centers contain corticodien-

Fig. 69

cephalic fibres, from the symptoms of this patient it is evident that the pathology responsible for the epilepsy as well as for gastrointestinal disturbances is situated in the frontal lobe of the cerebrum. The existence of grand mal convulsions in this individual automatically places the lesion in the cerebrum and not in the brain stem. The patient does not present positive neurological findings that would point towards a temporal lobe disturbance since there are no defects of smell function and no auditory hallucinations. For similar reasons, we can also safely state that the lesion is not located in the occipital lobe. As far as we know, this patient showed no hemiplegia and presented no positive extensive sensory findings in one particular side of the body. It is therefore evident that the precentral as well as the postcentral regions are likewise ruled out. The frontal lobe is therefore the only area,

which could be pointed to as the seat of the trouble producing generalized convulsions as well as gastrointestinal symptoms. This is furthermore substantiated by the absence of a Jacksonian type of epileptic attack. The above method of analysis will be followed in most of our cases. Wherever we fail to go into detail with the above method of arrival at an anatomic localization it should become evident that we have left it to the reader to carry out the procedure by himself. The illustrative diagrammatic data to be presented with each syndrome group should furthermore offer ample additional functional lobar, lobular and gyral data for the application of this method of residues, by those with a special leaning towards neuroanatomic differential diagnosis. Our rapid analysis of the above case, particularly with reference to the localization of the lesion within the frontal lobe of the cerebrum, might tend to disappoint the reader. He may feel that not enough positive neurological findings have been presented to warrant specific localization in this region of the brain. We can in this respect, set him at ease, by stating that in most of our syndrome group cases we shall present ample material consisting of picturesque aurae, functional disturbances, such as in speech, and sufficient clinical neurological findings to substantiate our conclusions. This case is only one of very few cases, in which the clinical neurological disturbances are so meagre. We can promise the reader that in most of our cases we will have so many findings of a functional positive objective clinical neurological character, that the extensive literature, which we have heretofore presented on the neurology of epilepsy, will all be backed by data representative of pathologic lesions. The greatest percentage of our cases will show, for instance, a definite pattern of attack and therefore the clinical literature presented by Davison and Goodhart will be confirmed. In most of our patients, the pattern of attack will also follow the general schemes set forth by Wilder Penfield, in which head, eye, and neck movements of a specific type, indicate foci of cerebral cortical involvement of the brain. Not only will the findings of the above authorities be fortified with extensive epileptologic neurological findings, but also the writings of Archambault and Fromm will be illustrated by positive evidence of wasting of various parts of the body in our epileptic patients. The reader will have no cause to complain that we have over-concentrated particularly upon the neuroanatomical literature, when we did not have enough material to substantiate our claims. We shall especially prove our point, not only in the above, but also in the presentation of cases showing definite gastrointestinal motor and other disturbances as proposed by Lennox and Cobb. The following case will prove this. Before we proceed to the next case it might be well to refer to Lennox and Cobb in relation to aura analysis. These authors analyzed 1,359 cases of epilepsy for aura. Although they presented an appreciable number of cases of idiopathic and symptomatic epilepsy with aurae referring to the gastrointestinal system in general, the cases suffering from epigastric and abdominal pain were few. In other respects, these authors were more exhaustive in their assignment of symptoms to the gastrointestinal tract. They included swallowing sensations, diarrhea, sensation in the

liver, faintness, distention, etc., etc. They checked their data against that of Gowers. In general, our aura groups resemble those of the authors mentioned above. We differ in one rather important respect, i.e., we have many more symptomatic cases than these authors, as will be shown by the appreciable number of cases of athetosis, hemianesthesia and hemiplegia and hemiatrophy, the neurological findings of which we propose to present in great detail, with each syndrome group.

Patient C. W. was admitted to the institution about the same time as the previous patient. She was a female who suffered from grand mal convulsions, preceded by an aura referring to the gastrointestinal tract. The abdominal symptoms occurred before attacks of convulsions, but mostly between them. These interparoxysmal attacks were much more pronounced than those of the previous patient. C. W. was really a problem in therapy, both medical and surgical, occasionally perplexing the physician on the case, as to whether or not abdominal surgery might be indicated.

She was 5′ 1″ in height and weighed 95 lbs. The loss of weight can definitely be attributed to her abdominal complaints. In contrast to the other case, who presented positive findings in the cardiovascular system, as well as a perforated ear drum, this patient showed no definite organic disturbances in these systems. Her pupils were equal and reacted to light as well as to distance. It seems that the gastrointestinal disturbances had a secondary functional effect upon her cardiovascular system, since her heart sounds were weak and so was her pulse, at times, having a rate of 72. She presented no positive findings on vaginal examination. She suffered from a thoracolumbar scoliosis. The lobule of her right ear was more adherent than that of her left one. Aside from the above she presented no evidences of paralysis except that the muscles of the left side of her face were slightly atrophied compared with those of the right side. Her extremities were not paralyzed; and in fact, all her reflexes were pronounced as normal and equal so that no pathological reactions were elicited. The type of her cranium was described as microleptocephalic. The head contour was described as oval, regular, and symmetrical. The greatest transverse diameter of her head was given as nine inches. The binauricular diameter (tragus to tragus), was given as five inches. The right auriculobregmatic (tragus to bregma), was given as five and a half inches, and the same number was given for her left auriculobregmatic. Her facial length was given as three and three quarter inches. The circumference of her head measured twenty-one and a half inches. Her binauricular arc was fifteen inches, and the anteroposterior diameter of her head was seven inches.

All of the above data might seem rather irrelevant since no definite localizing signs, such as paralysis of half of the body, point to a lesion either on one side of the brain or on the other except that the left side of her face was wasted, thus pointing to a possible pathological process in the right cerebral hemisphere. The absence of other cranial nerve changes with crossed paralysis, anesthesia, ataxia, or choreoathetosis paralysis associated, definitely places the lesion responsible for the

epileptic attacks as well as for her gastrointestinal symptoms, within the cerebrum, as against the brain stem. Lesions of the midbrain, pons, and medulla oblongata, whether such are the result of embolic or thrombotic processes of branches of the basilar artery or of the posterior arterial component of the circle of Willis, all carry specific syndrome characteristics and are known by names such as the Foville, Jackson, Benedict, Avellis, Weber, Raymond-Cestan, etc. In this patient, we do not find the slighest evidence pointing to the possible existence of any of the above syndromes.

The attention of the reader is invited to the gastrointestinal findings of this patient. The barium enema showed that the colon was incompletely filled. There was a perpendicular reduplication of the transverse colon, and a sharp angulation at its mesial portion, and at the splenic flexure. The haustral markings were very shallow in the lower portion of the descending colon, and they were absent in the upper parts of the descending and in the transverse colon, while the ascending colon contained no barium. If the reader compares the limited findings in this case, with the extensive findings in the previous patient as seen by our illustrations, he will be convinced that the severity of the abdominal complaints does not at all indicate the extent of the motor disturbance in the gastrointestinal musculature. The patient under consideration at present, complained much more, as will be seen from a detailed analysis of the progress notes, than the previous patient. For this reason we are presenting a detailed account of these two cases so that the reader might not take our classification of syndrome groups and the description of individual cases comprising them lightly. When we will eventually refer to abdominal pain or some other type of abdominal aura, it should be understood that there might be in addition, extensive motor as well as secretory disturbances in the patient's gastrointestinal tract, which subjective data is incapable of pointing to. For the above reasons we strongly urge the reader to review our detailed account of the findings made by Watts and Fulton on intussusception and related motor disturbances of the musculature of the gastrointestinal tract. From the cases which we will present in the future it will become evident that many epileptics suffer from gastrointestinal disturbance. Furthermore, gastrointestinal disturbances are not only confined to epileptics but are probably extensive in all mental cases.

In our anatomical descriptions we have made extensive reference to the literature on gastrointestinal disturbances in relation to diseases of the brain. We have not limited ourselves to duodenal ulcer, but even went far afield to show that many modern authorities point to the diencephalon as a seat of general gastrointestinal disturbances. That the diencephalon, and particularly the tuber cinereum, might be responsible for the association between gastrointestinal disturbances and actual psychosis has been pointed out by L. O. Morgan and a limited number of others. There is, therefore, no telling what might be hidden in the way of gastroenterologic skeletons in the closets of every mental institution. It might be highly revolutionary for us to elaborate further on the above subject of the role of the cerebral

vegetative system in psychoses, since related attempts have been met with unresponsive reactions in the psychiatric literature. We refer particularly to the extensive and rather illuminating work with definite organic unimpeachable evidence presented by no less an authority than N. D. C. Lewis, who dealt with the cardiovascular system in psychotics.

In our cases of epilepsy which presented gastrointestinal motor disturbances associated with aurae, we have been fortunate however, in the course of ten years of carefully planned study of this subject, to, not only examine neurologically over two thousand patients from which the gastrointestinal cases were selected, but to perform pneumoencephalograms on a large number of cases in general, and on a limited number of patients suffering from gastrointestinal disturbances in particular. With such a record of personal observations of the neurological status of many of the cases which we will present in our gastrointestinal group syndromes, we do not fear criticism that our conclusions might be too theoretical. In this particular patient we do not indulge in the listing of a profusion of symptoms. We merely intend to stress certain specific features. This will not be done with other cases.

Most of the attacks of abdominal pain in this patient C. W. came on after a convulsive fit. These attacks were invariably of such alarming nature that even surgery of the abdominal type was at times contemplated because of the severity of the pain. Some of the attacks would come on between, and independent of, convulsions. Her case was therefore occasionally diagnosed as recurrent paralytic ileus of nervous origin, coming on after convulsions, and periodic psychosis consisting of paroxysms of mental disturbance during which there is a peculiar train of mannerisms and abnormal speech behavior.

In spite of the abdominal distention, which was so severe that the abdominal veins were very much dilated, the patient nevertheless had an enormous appetite. At times she would devour all the food within sight. A number of the resident observers described her as a gourmand. In spite of the above, her weight was invariably twenty pounds below average.

It is unnecessary to repeat that voracious appetites are very common among epileptic patients and that such patients do not necessarily present the picture of mental deterioration. The mechanism of such a phenomenon is yet to be established. From the evidences presented from the literature, it seems not unlikely that the frontal lobe might not be responsible for such lack of control and of judgment of the operations of the internal mechanisms controlling the awareness of satiation, which is essentially a cortical process.

The frontal lobe is definitely at fault in both of the above patients. Pointing towards an involvement of this frontal portion of the brain, are the gastrointestinal disturbances combined with the mental changes that form a syndrome by themselves, since there is much more to the former than just eating and to the latter, than, just behaving.

In the above respects, we must again emphasize the view taken by Watts and Fulton, that gastrointestinal function is located mostly in this lobe. These two authors repeatedly insisted that the gastrointestinal tonic and motor disturbances might be explained on an extrapyramidal impulse conduction basis. We have invariably shown that the extrapyramidal route is not necessarily agreed upon by other authorities. That Watts and Fulton are not so far from the truth, might however be supported by the fact that the frontal lobe has, in the last two decades, been established as a center for the operations of such movements as seen in chorea, athetosis and dystonia as well as in control of cerebellar functions as noted in diadochokinetic, static and other coordinative movements. It has been shown by the papers of Gordon, Riley, and Lorente de No, that the functions of the gait, station, and coordination are localized in this portion of the brain. Sometimes the lesion in the frontal lobe is associated with a homolateral, and at other times with a contralateral atrophy of the cerebellar lobe. This atrophy of the cerebellum is not essential to the production of cerebellar symptoms, in all cases.

Although the cerebellum has been studied clinically since the time of Cruveilhier in 1829, it has only lately been established that the relationship between the frontal lobe and this organ is an important one. It has for instance been shown by Meynert, Munk and Ziehen, that the frontal lobes become more developed the higher the scale of advancement towards the human. One should therefore not be surprised to find that this portion of the cerebrum, which has been established as controlling gastrointestinal operations, should also control those emotional and feeling tone functions directly or indirectly related to the former. In the human, the prominence of the frontal lobe has been ascribed to the fact that the upright position has been fully developed.

On subsequent occasions we shall follow the ideas presented above, and show how they are related to the work of Penfield and Davison and Goodhart who related the action of eye, face, head and neck, to chewing, swallowing, phonation, facial expression and body movements, and the work of Davison and Wechsler who went further to clinically relate the phenomenon of the body turning to cortical function, based upon the observations of Horsley and others. It is therefore needless to emphasize the ideas of Watts and Fulton that gastrointestinal function might be carried by the extrapyramidal system along patterns of functions referred to above. If it does this, it is not inconceivable that these extrapyramidal functions of movement and coordination might be carried by the frontopontine and by the corticobulbar systems.

In the presentation of our cases we shall point towards clinical signs which will agree with or refute the above ideas. We can nevertheless see that such functions dealing with the march of activity on the upright position and in body turning, runs hand in hand with the advance in the scale of mental development. The localization of turning movements of the body and head seems to have suffered tremendously in the course of the construction of the various tests making up the

clinical neurologic armamentarium. Wartenberg, who is known particularly for his work on trophic phenomena as shown in the paper by Archambault and Fromm, has, during the past decade attempted to deal with the reflex mechanism of the neck region. Since 1936 when one of us (Weingrow), had to steer away from publishing data on head movements and concentrate on epilepsy, we have been made aware of head position, head turning, body twisting in modified gait routines and new reflexes, in the perineal and other uninvestigated regions. Our associates would try to stress the importance of muscle strength determination along rotational planes and the significance of all of the above, in relation to the circumcursiva type of epilepsy and in the interpretation of the mechanism behind circus movements. It is therefore not surprising to find that many of the patients who present gastrointestinal disturbances suffer at the same time from coordinative disturbances and from one form of psychosis or another. We shall verify this in this patient whose progress notes covering a decade and a half we are herewith presenting.

In 1933 this patient was described as walking around with her arms crossed and her head supported with one hand. She suffered periods of depression, during which she would weep bitterly, and periods of exhilaration during which she would sing loudly. At times she would sit in silence and be friendless, but would execute minor duties about the cottage. From the beginning, it was noted that she preferred to be alone most of the time and discouraged friendly advances by other patients.

In 1934 this patient was still described as having the appetite of a gourmand and yet her weight was still 95 lbs. She was still said to be a middle grade imbecile who was silent, depressed, morose and seclusive. She was said to be deteriorating both mentally and physically, at a slow rate. She was given to spells of weeping in disturbed periods during which she would weep for hours at a time. In 1935 she improved only slightly. At that time, her appetite was still said to be enormous. Although she would work at times, she was nevertheless periodically disturbed. At other times, however, she was quiet and well-behaved, still tending nevertheless to be asocial. During that year she gained about 5½ lbs. and her mannerisms consisted of walking about and swinging her arms above her head. In spite of the above she seemed more obedient than during the previous years. In 1936 she was still depressed most of the time and lost most of the weight she accumulated, coming down to 95 lbs. In 1937 she again seemed to gain 7 lbs., but she was still depressed, suffering periods of weeping. In addition to the weeping spells she would have periods of prostration when she would present abdominal complaints. During these periods of abdominal disturbances she would refuse food for days at a time. On subsequent days she would revert to her ravenous appetite and thereafter be slightly elated, walking around and swinging her arms as usual.

In 1938 she had to be hospitalized because she again suffered a paralytic ileus. She had to be hospitalized on four occasions during that year, each attack occur-

ring at a three month interval. These attacks would sometimes precede a convulsive episode and at other times it would follow such an event. The peculiar mannerisms and the peculiar speech following such an attack, and its panorama of gastrointestinal complaints, also pointed towards the frontal lobe but more definitely towards the left side of the brain. We are persisting in the drab repetition of symptoms occurring in this patient in their chronological order because we wish to impress the reader without reiteration of this statement later on, that similar descriptive data could be indulged in, in at least one hundred, out of the three hundred or so cases which we are about to analyze. Volumes would therefore have to be consumed in such an undertaking. It is needless to state, that those interested in the scientific management of nutritional and metabolic problems of institutional cases, should find the above statements rather stimulating and thought provoking along lines of further research. Our future references to the hepatic status of some of the cases will act as a constant reminder that much is being neglected in this rather voluminous report.

In 1940 it was noticed that she again lost the 7 lbs. which she had previously gained. Her menses were said to be regular. Examination of her lungs proved them to be negative, and her blood pressure was given at 100 systolic over 70 diastolic. Her memory was said to be slightly affected, since she stated that she did not remember when she entered the institution. She also stated that she does not understand why adults bother talking to her, since "she has the mind of a baby". At times she would present evidences of paranoid ideas particularly in reference to her treatment. During 1940 she was also hospitalized on three occasions for the abdominal complaints. She would lie in bed for weeks at a time without attempting to eat in spite of all persuasion. The complaints of abdominal pain were associated with those of pain in the back which radiated down into one leg. Both complaints were invariably accompanied by tremendous abdominal distention. Towards the middle of that year she improved slightly so that it was not necessary for her to be spoon fed. Colonic irrigation would invariably produce little fecal matter. Towards the end of 1940 her attacks seemed to subside and she responded to some extent to luminal medication.

During the early part of the next year she seemed to gain her composure to some extent. In March of 1941 and in May of the same year she again had minor attacks of abdominal pain. At that time her convulsions were said to number about eight per month. For the next three months she again became subject to frequent attacks of what was described as paralytic ileus, which seemed to respond to prostigmine therapy. Subsequent to the above she was comparatively well for some time.

In October of 1942 she was again hospitalized and prostigmine therapy was resorted to. In 1942 and throughout 1943 and 1944 she was reported to invariably respond to this drug. In the latter part of 1944 it was however decided that the prostigmine did not help her and abdominal surgery was considered a possibility.

This was however not carried out. During the subsequent two and a half years, that is from 1944 until 1946 she was closely observed by one of us (Pigott). During this time no surgical interference was necessary since she responded to various types of sedative medication.

From the above case it becomes evident that these patients are not only a diagnostic problem but form a therapeutic mystery of enormous scope, as well. Our chief and primary problem in such cases is the localization of the corticodiencephalic centers which might be responsible for the above and similar disturbances. We feel that once this is accomplished we will probably find a combination of surgical and medical factors as well. The literature presented by Lennox and Cobb offers not only detailed data resembling that of the above case but the effects of abdominal surgery in many of such patients. In the meantime it might not be inadvisable to remark briefly upon the type of sedative medication to which convulsive cases seem to respond the best. For the present we are not interested in spasmolytic medications since the various types of these will be determined by the result of our subsequent clinical findings. Our remarks will therefore refer exclusively to anticonvulsant drugs. We must again caution the reader with regard to the uncertainties involved in drug administration in extramural patients. In preceding pages we have given some of the factors involved in the administration of phenobarbital to clinic patients attending the outpatient departments of epilepsy clinics of city hospitals or of the large non-city hospital clinics. Even though the results with some special drug might appear favorable there are certain complications not only in the distribution of the medicine but also in the complications that arise from it that are not reported by the patient or the family. Aside from the above, some of the patients present psychotic symptoms resulting from idiosyncrasies, etc. It is therefore too much to ask of the average neurologist to cover psychiatry, neurology and drug therapy of epilepsy all of which are veritable fields in themselves.

Since the advent of the hydantoin drugs we have resorted to the same with some results. One of us (Weingrow) has however been especially interested in developing a method of massive dose phenobarbital medication. This method was started in 1938 when the other two collaborators (Fitch and Pigott) were consulted about this. Since then this method has been perfected in a few hundred patients, about 70 per cent of whom were able to return to their occupations. We hope to elaborate upon this method later or in a future publication. Fundamentally, we are not leaning with favoritism in the direction of any specific drug therapy since the eventual curative method will not improbably be surgical. However the malonylurea structure of phenobarbital is fundamentally not unlike that of the adrenalin sympathin group or it resembles it, at least, much more than does the hydantoin group. If the above is true, then we might have a fundamental structure to support the Keezer and Keezer assertion that phenobarbital has a specific selective action on the thalamus. The urea constituent of the hydantoin group

might, on the other hand, be an agent for the lysis of scar tissue in the brain of the epileptic. Such an idea has been advanced, but more work is needed in that direction. In the above two cases we dealt with the problem of visceral pain. Both of the patients suffer from abdominal pain which is associated with abdominal distention. In the first group of cases of gastrointestinal syndromes we propose to deal with the subject of abdominal and visceral pain. Before presenting the analysis of the cases which suffer from aurae which consists of abdominal, epigastric, quadrantic pain, it is befitting that we discuss the localization of this function of pain in its relation to that of other perceptions.

For more than one half of our paper we repeatedly dwelt upon the subject of mammillothalamic and spinothalamic systems. We invariably tried to decide whether one of these systems, or both, might be responsible for the neurogenic control of motor and secretory gastrointestinal functions. In the cases which we will present, it will be evident that pain perception, coming from the gastrointestinal tract stimulation might be carried in one or both of the above systems.

From our reference to the clinical and experimental literature on the mammillothalamic and spinothalamic systems, it becomes evident that the thalamus is the organ which is responsible for the modification of pain whether it is visceral or otherwise. From clinical experience every neurologist knows that somatic pain is conducted by the spinothalamic pathways. The impulses responsible for the conduction of pain and temperature sensation travel along these pathways, from the spinal cord through the medulla oblongata, through the pons and midbrain, along the lateral lemnisci and finally into the thalamus. From within the thalamus in its lateral nucleus, fibres conducting these impulses, emanate and are distributed into various portions of the cerebral cortex into the postcentral area and possibly into the parietal region. It is evident that the above cortical areas include those on the lateral aspect as well as those of the mesial view. It is in the fibres of the cingulate sulcus that we find association of many of such sensory spheres in the mesial aspect of the cerebrum.

There is a great deal in the literature regarding the distribution of these fibres from the thalamus into the cerebral cortex. All evidences point to the fact that these fibres fan out into a number of areas of the cerebral cortex. It might be, that more than the postcentral and parietal areas are covered by this fanlike distribution. It is also well known that within the optic thalamus there are fibres that are of the internuclear variety which extend from the anterior nucleus of the thalamus into the lateral nucleus. This would show that there is an intimate association between the mammillothalamic and the spinothalamic systems. If this is true, then visceral pain coming from the gastrointestinal tract could be appreciated in various pathologic conditions of the optic thalamus. Visceral pain might therefore be a phenomenon which occurs independent of the mammillary, tuberal, or preoptic region as neurogenic gastrointestinal impulse carriers. That this is not unlikely, is evident from the very familiar syndrome of thalamic pain.

That the above statements are not merely theoretical, is evident from the extensive literature which we have presented heretofore. We have given unimpeachable evidence to the fact, that the anterior nucleus of the thalamus has extensive connections with various portions of the outer and inner regions of the cerebral hemisphere. What has been said in the foregoing in regard to the relation between the mammillothalamic and the spinothalamic systems, might also be said in the relation between the former and other fibre systems traveling along the posterior columns of the spinal cord through the brain stem and into the thalamus. The system which runs along the medial lemniscus for instance, and conducts pressure sensations as well as vibration, also has an important relay in the thalamus. Following our presentation of the gastrointestinal syndrome of pain we shall present a syndrome which deals with visceral stretching sensations. Such sensations are evidently conducted along the medial lemniscal systems, while pain is transmitted along the lateral lemniscal or spinothalamic routes. Whether the consciousness of pain is localized in the thalamus or in the cerebral cortex, is not for us to decide upon. This subject of consciousness has occupied the minds of physiologists for the last two centuries.

Although every clinician has been interested in the problem as to whether visceral sensations can actually be perceived, no one has ever attempted to segregate those tracts which carry such impulses from the brain stem to the cerebral cortex. Only part of the above distance has been covered in the familiar syndrome of thalamic pain of anesthetic(?) limbs, resulting from cerebral vascular accidents. That a tremendous number of fibre tracts extend from the thalamus into the mesial and lateral aspects of the cerebral cortex we have shown in the extensive review of the literature. The real question to be decided upon is as to which one of these tracts might be responsible for the conductions of such impulses from the thalamus into, either the frontal lobes, or from the thalamus into the postcentral and parietal regions of the convexity and mesial aspects of the cerebrum. On the mesial aspect of the hemisphere, a conduction scheme such as the above, would lend support to the claim that visceral operations are controlled by the cingulate gyrus to which have been assigned various other autonomic functions, mostly on an experimental basis. According to Wilder Penfield and various others in the modern literature, it seems not unlikely that the thalamus, and particularly the entire diencephalon, is an organ which is self-sufficient, and capable of dealing with problems of consciousness in the form of perception. This might encompass sensory perception of visceral sensations, and of motor as well as of secretory functions. The above view of Penfield is supported by a number of bioelectric neurophysiologists. The last mentioned might point to the Wedensky and similar phenomena which maintain that groups of ganglia, and even those of the sympathetic system have as a specific function the modification of impulses. Before long we expect the reader to obtain an overall picture of the actual functional scope of the optic thalamus. We intend to offer this, not only from the cases which

we propose to present, but also from the relevant literature to be offered in the summaries and discussions of each case. There seem to be few functions, for which this organ, at the base of the brain, is not a way station or modifier. It may therefore be not unlike the transmission system of an automobile. In spite of the above, it should be remembered that this organ subserves the great projection and association pathways. The bicellular and tricellular topographic scheme along the longitudinal axis of the body of the long axone neurones, is the real force behind the impulse transmission system. Into this group fall the pyramidal and extrapyramidal neurone systems, and in it, are included the corticocerebellar pathways which will be shown to be involved in many of the cases to be presented. It is along such lines as the last mentioned, that we will find Watts and Fulton's views of gastrointestinal neurogenic functional control. That this is not unlikely in the case of perception of sensations of pain, visceral and otherwise, particularly somatic of the tactile and pressure types is proven by the experiments of Henry Head. The last mentioned author's investigations into dissociation of sensation, are insufficient as far as the visceral perception is concerned. In our writings on epilepsy we have repeatedly referred to the last mentioned authority in regard to the problem of modification of sensation by the thalamus. Whether Henry Head had in mind modification of sensation by this organ on a chemical and bioelectric basis we do not know. We have invariably been unable to separate this organ from the cerebral cortex, insofar as our sensory findings of neurological examination was concerned. We were however able, in about 2,000 cases, to substantiate the ideas of Henry Head in regard to the dissociation of sensation. The exact mechanism behind such dissociation, and in what way the thalamus operates in substituting and modifying the above, is difficult to determine. In spite of the fact that present day neurophysiologic evidence might tend to favor the view of Wilder Penfield in regard to consciousness and appreciation through it of sensation by the thalamus, we must register our opinion on the subject, since it is backed by clinical observations of over a decade. In our past publications we have shown how sensations are dissociated by cortical lesions of the brain according to the principles of Henry Head. We have made these observations, personally testing each patient and rechecking each case, while studying fatigability factors in each patient, and not relegating them to resident staff members of the various hospitals with which we are associated. We did so, because the ideas of Henry Head have thus far not been extensively incorporated into text books on neurology, although they have been emphasized by some observers. Lennox has reported upon some of the clinical neurologic findings in epileptics, but he made no specific issue of sensory phenomena and the problem of dissociation of sensation. Next to William G. Lennox, Wilder Penfield is probably the greatest authority on the subject of epilepsy of the present day and age. That the above is true is evident from the tremendous literature on the chemistry, electroencephalography and surgery of epilepsy. Although we do not in any way imaginable attempt to compare our experiences in the

field of epilepsy with that of such figures as above mentioned, we can nevertheless affirm that our experience in over ten thousand cases of epilepsy in close to three decades, is also not a small record. Our almost exclusive interest in the clinical neurology of this subject has limited and possibly contracted our viewpoint. We have, however, shown previously, that we are far from alone in our contentions. We have shown that Muskens, Brown-Sequard, Gowers, Claude, Maes, and the outstanding clinical neurologist Oppenheim, expressed the views which we propose, but each did so in a smaller number of cases compared to ours. These authorities did so in the heyday of the accumulation of data confirming Jackson's cortical irritation views. We therefore maintain that the cerebral cortex is just as important as the thalamus in the appreciation of pain. We are of course, primarily interested at present, in the type of pain as it relates to the gastrointestinal tract, i.e., visceral pain. Even here we find that the experiences of Lennox and Cobb supersede ours, especially in their analysis of 1,359 aurae in 750 of which they gave a classified account of incidence of various special types. In these they even discussed headache, pains in the face, tongue, mouth, lips, legs, arms, region of the heart, rectum, etc., etc. Although the data by these authorities checked well with that obtained by Gowers in a similarly large collection of cases, our material contained more patients suffering from the symptomatic type of epilepsy. Furthermore, our cases were directly questioned and in some, the few instances, the aura was reproduced together with the fit by the method of carotid sinus compression. As a result of the above, we found that it was rare for pain to occur as an isolated aura unassociated with visual, olfactory, gustatory, motor or other preparoxysmal experience.

The preceding statements, although sounding rather sophisticated, omniscient and authoritative are really not intended as such. Our interests, as has been repeatedly shown, lie almost exclusively within the realms of the mammillothalamic tracts and within the spinothalamic system which has now taken the form of the question of conduction of pain from the gastrointestinal regions. The neurological findings to be presented with this syndrome group, are so definite and so simple, as far as their utilization for localization purposes is concerned, that one hardly needs neurological training to be able to arrive at definite conclusions with regard to the anatomic situation of brain lesions in most of the cases. We will therefore proceed to present our data in about 60 patients who suffer from abdominal pains of all types in whom these occur mostly before epileptic spells. First, we will give the incidence of each type of abdominal aura in relation to the exact location of the abdominal pain and other characteristics. After that, we will review these aurae in the entire group and also sketch the probable causes of the epilepsy in these patients, as well as the incidence of grand mal and petit mal as well as the time of their occurrence, in relation to day or night. We regret that we cannot give a detailed analysis of the causative mechanisms in the entire group of cases of abdominal pain complaints. For this we refer the reader to our previous elaboration of

hereditary and traumatic factors in the causation of brain diseases which are complicated by epileptic fits. Subsequent to our scanning of the entire group syndrome of cases of abdominal pain aurae, we will devote a rather great number of pages in an attempt to present special cases as completely as possible. The reader will then be able to see for himself whether pain is localized in the mammillothalamic or in the spinothalamic systems or in both. Whatever the ultimate decision may be, it is essential to stress the fact that our main purpose, besides establishing a neuroanatomic basis for visceral pain, is to stress diencephalic and corticodiencephalic syndromes dealing with pain in general. We have shown that such syndromes have not been concentrated upon by text books other than in the reference to thalamic pain in anesthetic limbs. Should the complaint of abdominal pain in some of our cases be conceived by some readers as emanating from the parietes, rather than

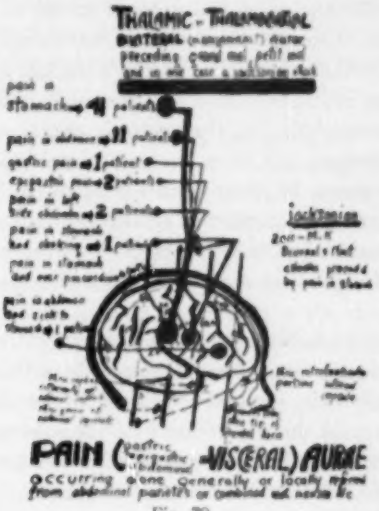

Fig. 70

from the viscera, we will have accomplished the second mission instead of the first one.

The illustration which deals with cases of abdominal aurae refers to them as thalamic or thalamocortical bilateral (or unilateral) aura, preceding grand mal, petit mal, and in one case a Jacksonian attack. The illustration in Figure 70 represents a view of the right side of the brain that has been divided into five portions by vertical lines which represent coronal planes passing through the respective areas at which they are situated. The first plane passes through the frontal lobe, in the region of the tip of the frontal horn. The second vertical line, representing a plane, passes through the cephalic extremity of the internal capsule. The third line, representing another coronal plane, passes through the genu of the internal capsule. The fourth and last line, representing the final coronal plane, passes

through the retrolenticular portion of the internal capsule. Situated in relation to the above lines, are certain numbers, some of which are located next to letters. If the reader will refer to some of our previous illustrations dealing with functions of cortical areas, he can readily see what specific functions each number represents. The numbers in the occipital region are 17, 18 and 19. Stimulation of the cerebral cortex in these regions produces various types of visual phenomena. Color variations ranging from yellow, to blue, to red light, are specifically localized in such areas. A common finding in the cases to be presented are visual hallucinations which go hand in hand with the gastrointestinal pain aura. We do not know whether such hallucinatory phenomena, or even the gastrointestinal cerebrogenic referred pain, arises from impulses set up in the areas proper or are produced by indirect stimulation in the thalamus. Foerster and Penfield produced such reactions in patients by stimulation of the exposed cortex in the operating room. It should be remembered, however, that with a convulsion we deal with a trigger area in a pathologic portion of the cortex. Pike's dictum states that dead cells are incapable of producing impulses. Therefore, one might possibly conclude that it is from the live cells underneath, i.e., the thalamic neurones that the epileptic perceives the pain impressions, and from the geniculate region of this structure derives the visual phenomena. In front of this occipital region are the parietal and postcentral regions. In the last mentioned locality, certain sensations such as touch, vibration and other varieties of phenomena of the sensory type are located. Some of the last mentioned structures are associated with various types of abdominal aurae of pain.

Abdominal pain is probably localized in the cerebral cortex of this postcentral region. The detailed description of the various areas within the cerebral cortex, as presented above, is specifically stressed at present, so that the repetition of the same should not be necessary in the presentation of the subsequent series of diagrams which contain essentially similar numbers. Particular attention should be paid to the coronal plane levels representing the internal capsule. The reader should therefore compare the above figure and every similar one to follow, with Figure 1. The last mentioned illustration gives the structures contained in the internal capsule in general, stressing those items represented by the coronal planes. If the gastroenterologist is interested in figuring out for himself, what types of abdominal complaints might be associated with actual neurological motor or sensory disturbances all of which can emanate from capsular structures, it will be up to him to refer extensively, not only to this and subsequent illustrations, but also to a number of the preceding ones.

In the diagram referred to above, we see that the pain aurae which are referred to as possibly visceral, or coming from the abdominal parietes, might occur alone or be associated with symptoms such as nausea. The group of patients in whom general pain in the abdominal sector, without reference to any specific portion thereof, was found, as an aura, consisted of forty-one individuals. Pain in the

abdomen was also found in eleven patients, without any specific reference to the exact location, except that it referred to the anterior portion of the subthoracic region, instead of to the lumbar location. One patient merely said that he suffered from "gastric" pain. Two patients stated that they suffered from an aura consisting of pain which was located in the epigastric region. In another two patients, the pain which occurred as an aura referred to the left side of the abdomen. One patient stated that the pain of his stomach which occurred before an epileptic attack was also accompanied by a choking sensation. Another patient stated that in the period before an epileptic attack he not only suffered from pain in the abdomen, but was also "sick to his stomach". In still another patient the pain in the abdominal region radiated over toward the precordium and both occurred before an epileptic attack. Finally, one out of the 60 patients referred to above, suffered from Jacksonian attacks, and these were preceded by pain in the abdomen. No definite situation of the pain, i.e., as to whether it was right or left sided, or whether it occurred on the same side as the epilepsy, or on the other side could be obtained from the last case recorded.

The subject of pain as an aura is a very confusing one. The clinician does not know whether to interpret this symptom as representing motor or sensory dysfunction or as both, or neither. In the first two cases which we have presented in detail, we have shown accompanying pictures which prove that the abdominal pain is associated with changes in the musculature of the intestinal tract. It is therefore to be decided by the clinician whether the process setting the impulse into operation, which is eventually interpreted as pain, starts in the viscera or in the cerebral centers. In the case of the "thalamic pain syndrome" the cells in the thalamus are believed by some to be the structures which initiate such impulses. The above statements apply not only to this group of cases of sensory disturbances, but to all the other similar syndrome groups as well. Only in those syndromes associated with nausea and vomiting are we definitely certain that the starting point of the gastrointestinal aura begins in the cerebrum and is associated with the same trigger zone which starts the epileptic attack. Even in the above, we meet the rather revolutionary feature of the Pike dictum that no one has ever obtained an impulse from a dead cell. We will refrain from further comment regarding the above. Pike's dictum might overthrow the accepted concepts that choreiform, dystonic and even athetoid movements do not originate in the basal ganglia where the pathology is located in striatal disease, and favor cerebral structures where the cells are not dead. The above would probably be refuted by the neuropathologist, affirming that some of the cells in a brain scar, or area of degeneration, might be alive, and that such would be the carriers and originators of the abnormal involuntary movement or epileptic reflex impulses. One can readily see how theoretical such subjects are. We will therefore leave the reader with the above ideas and return to present our material on the syndrome of abdominal pain.

In the above group of cases we find records on individuals who were living at the time of the examination. In other cases, the records of dead patients though defective, are nevertheless listed. A smaller number of patients were discharged from the institution and very few cases were transferred to other institutions. In this group of patients in whom pain in various portions of the abdominal region was present as an aura 24, patients were living at the time the study was made. A group of 20 patients had died at that time. Nine patients in the above group of pain aurae had been discharged from the institution and one case was transferred to another institution. On a previous occasion we emphasized the point that the type of seizure and especially the seizure frequency, is very important in gastrointestinal cases. We thought that if a patient had many epileptic attacks associated with contractions of the intestine that they would eventually result in local changes in various structures within the tract or connected with the same. Under the individual case presentations in this group we shall therefore present detailed data on the seizure frequency in some of the cases. We urge the reader to pay special attention to such data in relation to the neurological findings. In the meantime, we will give the incidence of seizure types in this entire pain aura syndrome. Forty-four patients in this group suffered from grand mal epileptic attacks. Most of these patients with such attacks suffered from petit mal seizures in addition. In ten patients of the above group of pain aurae, only petit mal attacks without the major variety of fit were reported as present. One patient in this entire group of pain aura syndrome was said to be suffering from Jacksonian epilepsy. In five patients the record was deficient with regard to the type of attack. A significant feature of the above record of seizures is the fact that all of the patients, except four, suffered from nocturnal attacks as well as from diurnal ones. It should be emphasized with this syndrome group so that repetition is not necessary later on, that the digestive absorptive and assimilative process, although essentially a diurnal class of functions might be conceived as extending to nocturnal hours. If the motor and secretory functions are slowed up because of cerebral neurogenic dysfunction, we might expect that gastrointestinal pathological processes might be the starting factors stimulating cerebral trigger zones, in the same way as seizures of a sensory type are started by peripheral stimulation or an auditory startle reflex irritation. We have previously reported upon the Brown-Sequard type of epilepsy which also works on a mass reflex basis, as do the myoclonic shock phenomena induced by peripheral stimulation. The associated pain or this symptom of abdominal pain occurring with attacks, is probably responsible for the interest of the family in its symptom as a causative agent in the epilepsy. For this reason many of the records of gastrointestinal cases contain "indigestion" as a cause of the fits. Such an etiology is, most of the time, volunteered by a relative or the patient himself. The existence of attacks of abdominal pain, occurring so frequently at night, adds a factor of alarm and concern involving the life of the epileptic and often directs the members of the family to this region of the human anatomy, causing them to fear appendicitis, gallstone attacks, or even renal colic; and not infrequently in-

vites the abdominal surgeon to the solution of this problem. Should such a nocturnal attack occur in relation to menses, then, ovarian cyst or tubal disease becomes implicated.

Aside from indigestion as a cause of the seizures in the above cases, teething was not an infrequent one. "Worms" was mentioned in one case and the drinking of ammonia was given in another patient, as a cause of the epileptic attack.

Next in frequency as a causative agent in the epilepsy of this pain syndrome group, is trauma. In our presentation of the case histories of the 300 cases, we have emphasized the importance of getting a detailed history of injury. We will not go into detail regarding this, or with the method of eliciting a hereditary history. We caution the reader to refer to previous pages for these items, since, whenever such causative data is presented, a thorough search has to be made in each case. One of the patients in this group of pain syndrome, was injured in a fall. A second, fell on his head. A third, was struck on his head. In one, birth injury was given as a cause of the epilepsy. Scarlet fever was also given as a cause of the epilepsy in two patients in this trauma pain syndrome group. One patient was injured in a fall during an attack of whooping cough, and another patient began to suffer from epileptic fits, after an attack of influenza.

In two patients, infantile paralysis was given as a cause of the epilepsy. It is interesting to note that, in only one patient out of this entire group, heredity was mentioned as a cause of the epilepsy.

Throughout our previous discussions we were very emphatic about the terms mammillothalamic and spinothalamic systems. We emphasized the work of Watts and Fulton as well as that of Spiegel in the above relationships. It sounded very simple, especially, when we offered a detailed anatomical scheme to prove that disturbances in the gastrointestinal function may be neurogenically placed in one or the other of the systems. From the problem of pain as a visceral symptom associated with epilepsy, it becomes evident that this problem is not quite as simple as we thought it to be. Pain in the abdomen may be due to motor disturbances. It may, on the other hand, be caused by a lesion in the brain which is associated with the conduction of pain, such as we especially see in the thalamic syndrome.

The complexity of the subject of abdominal pain as a symptom associated with seizures does not however mean, that the cause of the trouble in the epileptic, starts in the abdominal viscera; although this is not unlikely even if the trigger zone is central. In almost all of our selected patients, we have definite proof that the origin of the gastrointestinal disturbance is in the brain, and that the trigger zone which starts off the gastrointestinal disturbance is, in most instances, the same one which starts off the major train of symptoms of the epileptic attack. Under the presentation of data with each case, we will leave it to the reader to decide as to the probable focal location of the seat of the trouble within the brain. With the illustrative material which we offer, and the approximate level of sensory and motor portions of the internal capsule, in over ninety per cent of our illustrations, the reader himself

might be able to determine to which of the above modalities the pain is most related. We have said enough about the corticomammillothalamic system as distinguished from the spinothalamic pathways.

The exact location of a lesion in the brain or spinal cord which is associated with pain appreciation disturbance, as a somatic experience, is easy to determine for the average neurologist. The examiner merely sticks the patient with a pin or pinches him in various spots of the body and determines the ability or inability for the patient to experience this sensation. The examiner then decides as to whether the seat of the trouble causing the inability to appreciate pain, or to complain of the same when it does not exist, is located in the spinal cord, brain stem, or higher up. This decision is easily arrived at, since the tracts conducting somatic pain are definitely mapped out. This is not the case in visceral pain.

For the above reason of insufficient mapping out of diencephalic and cortical centers for visceral pain we find that the neurologist and neurosurgeon have thus far not found the solution of treatment of conditions such as migraine, trigeminal neuralgia, and causalgias of various types. We can mention similar diseases in which this problem of visceral pain is involved. At present we are however only interested in this subject as it relates to the telencephalic and diencephalic centers. We therefore offer the reader detailed descriptions of our cases, some of which even have the characteristics of migraine by their headache, in the radiation of the abdominal pain, the visual disturbances and the temporal incidence of spells at menstrual periods.

Aside from the solution of the problem of abdominal pain associated with the cases in this syndrome group, we have another most essential problem to solve. This problem consists in impressing the reader with the facts of the worthiness of the case records, particularly with reference to the fact that they deal essentially with cases whose brain lesions are located in the cerebrum and not in the mesencephalon, or other portions of the brain stem, or in the spinal cord; or even in the peripheral nerves. From the above standpoint, and because of the fact that not only the literature on epilepsy, but also that of general neurology contains very few instances of actual clinical cases in whom a brain hemorrhage, brain abscess, or brain tumor is located in such a portion of the diencephalon or cerebral cortex and which when associated with abdominal pain produces gastrointestinal disturbances in addition, we believe our proposed data to be of unusual importance.

We have previously shown how an outstanding neurologist, such as Archambault, utilized only three cases from his entire collection, and assembled a great deal from the literature in the form of a lengthy paper, to prove certain anatomical facts. We offer to do much more than that. In this group of abdominal pain syndrome cases, we will set out to impress the reader with the fact that lesions such as seen in hemorrhage in the cerebrum are accompanied by gastrointestinal manifestations as well as a paralysis of one side of the body and other features to prove that we are dealing with definite areas which we claim to be the seat of the trouble that pro-

duces the gastrointestinal syndromes. We could have selected only a minimum of such visceralgesia cases, that show implication of the mammillothalamic or spinothalamic systems. About ten or fifteen patients, presenting a paralysis of half of the body, would have justified our elaborate introductory descriptions.

We however are not merely interested in justifying our presentation of new material to the literature. Eventually, we will show, that the main points brought out by us in dealing with the work of Watts and Fulton as well as with the efforts of Hare and Donal Sheehan, can be solved by reference to our case records. We have invariably referred to Watts and Fulton with regard to the neurogenic control by the cerebral cortex of gastrointestinal function. We confess our neglect of Donal Sheehan's report with respect to similar control by the hypothalamic structures. Whenever we spoke of the mammillothalamic pathways we invariably had reference also to pioneers such as Beattie and Cushing. It is hoped that the frequent mention of the term mammillothalamic, and that, really was frequent, has automatically conveyed to the reader the above names. Such descriptive effort, and self-evident references should be applied by the reader to other syndromes which we will describe in great detail later on.

(*To be continued*)

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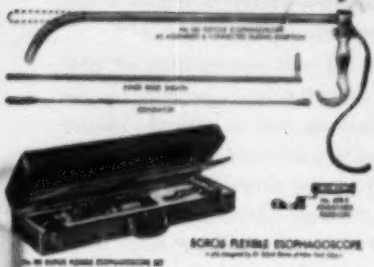

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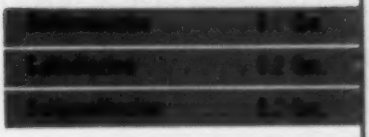

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1. Offenkrantz, W. F., *Rev. Gastroenterol.*, 17:359-367 (May), 1950.

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1. Weiss, S., et al.: Rev. Gastroenterology 16:501-509 (June) 1949.

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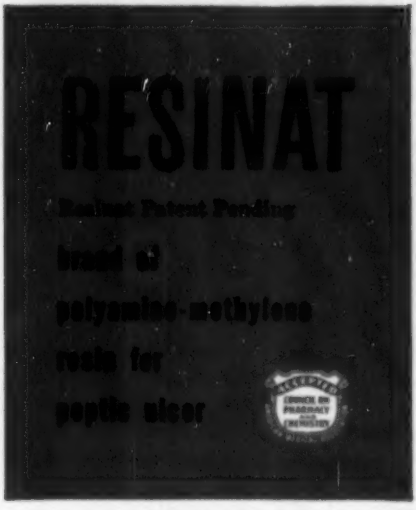

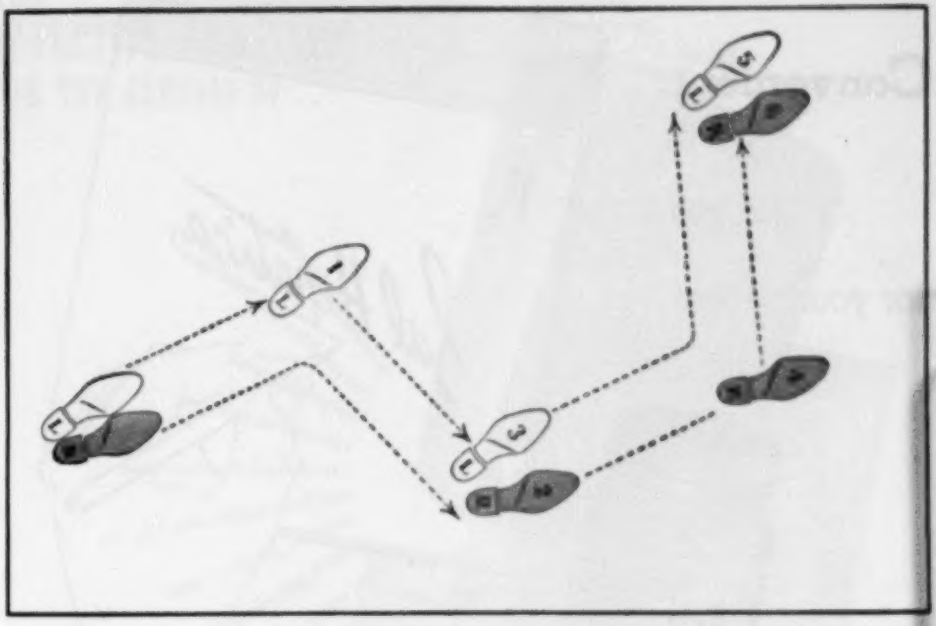

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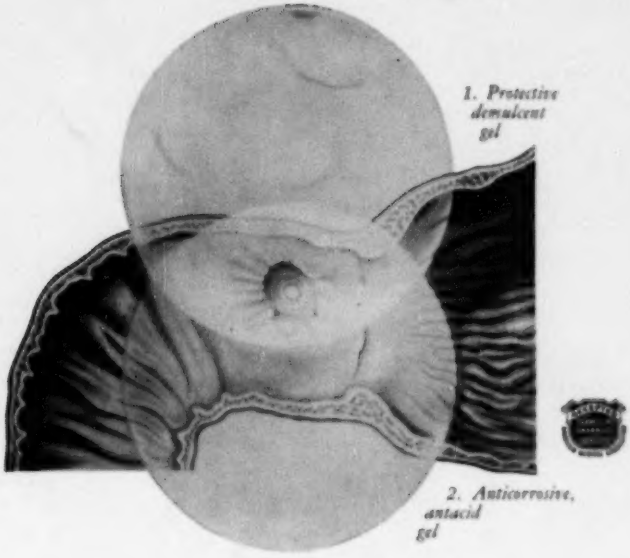

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